THE HALF-TONE Process.

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Nov 23rd 1896.



Photo by *Trotter, Crieff.*

HALF-TONE ETCHING ON COPPER.

BY THE AUTHOR.

Levy Screen, 133 lines.
Wet Plate Negative.
Enamel Process.

THE

HALF-TONE PROCESS

A PRACTICAL MANUAL
OF
PHOTO-ENGRAVING IN HALF-TONE
ON
ZINC AND COPPER

BY

JULIUS VERFASSER

With fifty-six Illustrations, including Sketches and Examples of Work by the Author.

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Part I.

THE ATELIER, FITTINGS, TOOLS, AND APPLIANCES.

PREFACE.

THE present work, the first that has been issued—in the English language, at least—dealing with "The Half-Tone Process," makes no pretensions to exhaustiveness. The popular price at which it is issued rendered it necessary that the subject should be treated concisely. My difficulty has, therefore, been to be comprehensive whilst being brief; I hope I have succeeded in this respect.

My aim has been to make the book a practical manual, and I have studiously avoided theoretical considerations. The appliances and processes I have treated are such as are in use to-day in the leading half-tone studios, and I have described no method but of which I have had personal experience.

To those who take this book up as a guide, let me say that there are few businesses which depend for success so absolutely upon working under proper conditions, and with suitable appliances, as that of half-tone. I have avoided explaining how this or that may be used as a makeshift. If any of my readers depart from these instructions in an endeavour to modify the method or dispense with

some of the essential appliances, they must only blame themselves if they fail.

As the numerous illustrations to this work so greatly increase its usefulness, I must express my indebtedness to Messrs. Penrose & Co., of the Photo-Process Stores, Clerkenwell, London, for not only lending all available blocks of their own specialities, but also for collecting from abroad *clichés* of goods for which they are agents.

It is possible that I shall be blamed by some of the older members of the trade for having written such a book at all. But the time has surely gone by for the old-fashioned jealousy against trade handbooks. The spread of technical knowledge is now recognised to be as essential as elementary education to the progress of the community, and so far from a trade being injured by publicity, its methods may be, in fact, improved, not only through the accession of new blood, but also by the old workers finding their own knowledge increased and enlarged in the perusal of handbooks and trade journals.

JULIUS VERFASSER.

Chapter I.

WHAT IS HALF-TONE?

We have first to consider what is meant by the term "Half-tone," as applied to the making of blocks by photographic processes. The earliest experimenters found that whilst it was quite possible to produce photographic pictures on metal plates, they were not able to engrave the pictures into relief, unless they had to deal with simple black and white: the black represented by the parts in relief, and the white by the portions lowered by etching or other means. Thus, if the picture was in lines, as in a copy from a steel or wood engraving, or pen and ink drawing, it was quite easy to reproduce these lines *fac-simile* by photo-mechanical means, but an ordinary photograph from nature contains, besides black and white, medium tints which we describe as half-tones, and which give contour and relief to the picture. Suppose we try, by one of the methods which I shall hereafter describe, to transfer to a piece of zinc the image from an ordinary photo-

graphic negative from nature; when we have sensitized the zinc plate we may expose it under such a negative, but on proceeding to develop after inking it over, we see that the whole of the picture washes away except the heaviest shadows, the whites being represented by bare zinc. It is a picture without half-tones, and therefore quite valueless. The question then arises: how can these half-tones be retained?

In succeeding chapters I shall explain the most practical way of accomplishing this, but, describing it generally, it was found that by breaking the picture up into a grain or stipple, the half-tones could be secured. This was attained by the simple means of interposing between the sensitive plate and the lens a network of fine lines, such as, for instance, a piece of fine wire gauze or muslin, but, preferably, a transparency of mechanically ruled lines. Naturally, the effect of interposing such a network dissects the picture into a series of dots. Now, if these dots were all of the same size, as are the spaces of the network, there would be no picture, but, fortunately for the purposes of our process, diffraction of light takes place; that is to say, when the rays from the lens strike through the network they spread more or less according to their intensity. Therefore, where the light strikes through most strongly, as in the whites of the

picture, dots are formed much larger than the spaces of the network; where the light comes through of medium strength the dots are, of course, of middling size; whilst in the dark shadows they are not larger than the spaces of the network, or, as a matter of fact, may not show at all, leaving the negative transparent in that part.

If such a negative is printed upon zinc it will be found to give a very fair representation of the gradation of the photograph. It will, however, have the disadvantage that the image will consist of crossed lines, because there was a transparent space surrounding the dots on the negative. This can be readily overcome, as subsequent chapters will proceed to show, and dots, instead of lines, produced. This latter appearance is necessary because it has been found that not only do dots give a better rendering of half-tone, but they are less liable to be filled up when the block is printed upon the letterpress machine.

I will ask my readers to turn to the frontispiece of this work for an illustration of my preceding remarks. If this picture is examined under a powerful magnifier the dot-system will be better observed. It will be seen that in the high-lights, *i.e.*, the whitest parts of the picture, the dots are very small; in the half-tones they become larger; and in the shadows they spread to such an extent

that they touch each other, and so form lines crossing one another. It is difficult to conceive at first sight that this effect has been brought about mechanically by the action of light passing through the regular sized meshes of the network, yet such is the fact.

Once a grained negative is secured as described, it is quite easy with reasonable care and skill to transfer the image to a metal plate and etch out the bare portions surrounding the dots, until they stand in a sufficiently high relief for printing from.

There are many other methods of dissecting the picture into a grain in order to bring up the half-tones, but in this work, in order to be simple and practical, I shall only describe the method now chiefly used by commercial firms, viz., that of using immediately in front of the sensitive plate a cross-ruled screen consisting of opaque black lines on glass, these lines being produced either by engraving them into the glass, and filling in with a black substance, or by photographing the lines on to the glass plate.

Chapter II.

THE STUDIO AND ITS FITTINGS.

Any studio built for photographic work will do for copying for the half-tone process, but in case it is found necessary to build a place I may indicate an essential plan. As a basis of calculation for the length of the studio one must first decide on the proportions of the largest picture to be worked. In general it is seldom that the majority of workers go beyond 15 × 12 inches, and this is a very useful size to work to. Assuming this is chosen, we know that it will be necessary to use a lens of not much less than 20 inches focus. Further, we know that to copy same size as the original with a lens of 20 inches focus it will be necessary to place the picture 40 inches from the stop of the lens, and extend the bellows of the camera 40 inches. If we have to reduce the picture to one-fourth size, the camera will have to be placed 8 feet 4 inches from the object, and the bellows would be extended 25 inches. It is evident, therefore, that we cannot do with less

than 12 feet working length of studio, and even that will be very close measurement. The next consideration will be the width of the studio. Here one must bear in mind that it is necessary to work with a mirror for reversing the negatives, consequently the camera must be placed across, and not lengthways to the room. A 15×12 copying camera should have a base of at least 40 inches, and as there must be plenty of room to walk past the camera at each end it will be seen that it is impossible to do with less space than 12 feet long and 9 feet wide for the working of one camera. In the matter of height there is no rule to observe, but it is well to remember that a fairly lofty studio gives better ventilation, and can be maintained at a more equable temperature. If it is intended to work the electric light, as well as daylight, it is necessary that the studio should be rather lofty, in order to sling the lamps well above the camera. I should certainly recommend that the studio for all purposes be not less than 8 feet high to eaves, and 10 or 12 feet to ridge of the roof. It is naturally best that the lighting should come from the north, though any other position can be made use of with the aid of blinds, which, however, are not desirable. Side lighting, as well as top, is useful, but it is well to avoid too strong a light coming from one side. A perfect light upon the copying board would come from

top and both sides at equal distances. Failing side light the walls of the studio should be whitened or white screens set up at each side. It is not necessary to carry the glass on the roof the whole length of the studio. It is, in fact, better that the end of the studio where the camera is placed should be in comparative shade, so that the focussing be done with ease. The studio should be solidly built to prevent vibration, though this may be overcome, as I shall presently show, by swinging the camera and copying board. The beams supporting the roof should be strong, especially if the electric lamps, camera, etc., have to be swung from them.

With respect to the relative advantages of swinging the camera or placing it on a table stand, a rule that will hold good in all cases is this: If the studio is at the top of a lofty building, with machinery in the basement or on the lower floors; or if it is situated near a railway or busy thoroughfare, in either case a great amount of vibration being caused, it is necessary that the camera and copying board be suspended on one bed frame from the beams of the roof.

It is a mistake to assume that the best place for a studio is at the top of a building. Wherever space can be spared it is best to have it on the ground, the floor being laid with concrete, with tram rails set in for the camera stand.

Having secured your studio, you must next consider the fitting up of it. The camera is the first and most important consideration of all. I have already indicated that it will be necessary to work with a long focus lens, and that to copy same size it will be needful to have a camera extending to twice the focal length of the lens. The wooden bodies of the camera should be square, and of good depth for the sake of rigidity. A middle body serves the purpose of keeping the bellows from dropping. It should be possible to slide the front body back, instead of rigidly fixing it at the end of the base, so that when copying with the bellows closely shut up one can avoid having to lean over a long stretch of tail board to focus. Here is an illustration of a useful camera for the purpose (fig. 1).

It is essential that the dark slide should be especially constructed for the purpose of half-tone copying. It must be nearly, or quite double, the thickness of an ordinary dark slide, and it must be constructed to stand the wear and tear of wet-plate work. It is usual in building slides for wet collodion to more thickly and strongly varnish them, to be more particular in jointing and glueing of the framework, using no nails or screws, and only selecting the most seasoned wood. The wire corners to hold the plate from falling forward must be of silver, any other metal,

except perhaps aluminium, would affect the sensitive plate. With regard to the question whether carriers should be nested one within the other, or of full size, I think the advantage is with the nested principle. The full-sized carriers warp and twist sooner or later, and this is a fatal defect, because if it throws the plate even a little out of parallel to the screen a different dot effect may be caused in one portion of the negative.

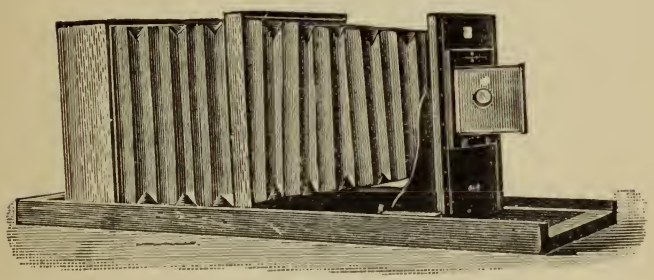


Fig. 1.

The screen is usually placed in a separate carrier in front of the usual plate carriers in the dark slide. It is necessary that there should be more than just the depth necessary for the screen carrier, because, as I shall presently show, it is necessary to have a certain amount of adjustment for the distance between the screen and the sensitive plate. A simple way of accomplishing this is to have a dark slide with a space for the screen carrier twice the depth of the latter—

that is to say, assuming the screen carrier to be $\frac{1}{4}$ inch thick, there should be $\frac{1}{2}$ inch depth for it to rest in, so that it will have $\frac{1}{4}$ inch play. To keep the carrier from falling forward there should be flat clip springs in front (fig. 2.)

It is evident that it will now be quite easy to send the carrier further away from the sensitive plate carrier by means of strips of cardboard placed between the two, or, better still, by cut-out frames of cardboard of different thicknesses, say $\frac{1}{32}$, $\frac{1}{16}$, $\frac{1}{8}$ in., other distances being secured by combinations of two or more of these frames.

Any camera for making negatives for printing on zinc should be fitted with a mirror box and optical plane mirror, which costs about 1/- per square inch. This article is a piece of the finest plate glass, about $\frac{3}{16}$ inch thick, ground down on one side until it is optically flat. It is then silvered on the surface—*i.e.*, the side which has been optically worked—not on the back of the plate, as in the case of an ordinary household mirror. The reason of this is obvious, for if you try to photograph a reflection in an ordinary mirror a double image will result, one reflected from the surface of the glass, and the other from the silvering at the back.

An optical mirror must be very carefully used or it will soon become tarnished and scratched, and must then be resilvered, this

resilvering, which costs about one-fourth the price of the mirror, will form a serious item of expense, if it has to be often done, and will involve stoppage of work for two or three days, unless one has another mirror to go on with. But if due care is exercised a mirror surface should last a long time.



Fig. 2.

A—Framework of dark slide.
B—Back lid of dark slide.
C—Plate carrier.
D—Wire corner.
E—Cardboard separation.
F—Screen carrier.
G—Spring.
H—Shutter.

The mirror should be carefully put away, when not in use, in a case which is air, dust, and damp proof. If the surface becomes a little tarnished get some finest jeweller's rouge, well dried by spreading it out on a sheet of paper on

top of a stove, and well rubbed to powder. Now take a tuft of cotton, also warmed to dryness, and rub it in the rouge, then upon a sheet of clean glass, so as to smooth down any grittiness of the powder, finally applying it to the mirror with a gentle circular motion, and patiently rub until the tarnish is worn off.

The mirror plate fits in a box (fig. 3), having one plane set at an angle of 45 degrees when fixed on the front of the camera. The lens is fixed on the opposite plane of the box, and when the camera is placed sideways to the object, the lens pointing towards the latter, the image is reflected through the lens, reversed as all the images are, but the mirror catches the reversed picture and reflects it to the sensitive plate the correct way, *i.e.*, the same as we would look at the original. When the resulting negative is laid film down in contact with a zinc plate the image is again transferred reversed, but when the printer subsequently lays a piece of paper on the inked plate, and takes off an impression, the picture comes the right way again. I make this simple explanation, because it is often very difficult to make people understand the necessity for a reversed negative, though if they ever attempt to take a print directly on zinc from an unreversed negative of some lettering, they will be taught completely the necessity for making reversed negatives.

Mirrors are usually about 7×4 inches, $7\frac{1}{2} \times 4\frac{1}{2}$, or 8×5. The rule is that they should be larger than the diameter of the lens one way, and more than twice the diameter the other way. Two should be purchased, so that one may be in use whilst the other is being silvered.

Next we must decide on the lens, and this is an easy point to settle, as we are dealing only



Fig. 3.

with half-tone. It must be of the rapid rectilinear type, and of long focus. Its covering power, as regards extreme sharpness to the corners, is of comparatively less importance in half-tone than in line work. What we want is a lens with a narrow angle, so that the rays will strike directly through the screen, instead of being obtusely refracted as with a wide angle lens. A lens of the latter type will invariably give blurred dots on the plate,

unless the screen is quite touching. But it is inadvisable to have the screen too close, both by reason of the fact that we are working wet plate, and also because the proper effect is not secured unless a certain distance is allowed. Again, a wide angle lens is always slow, and for that reason is unsuitable. It also shoots a lot of unnecessary reflections into the camera, which prevent the screen working at its best.

Ross' Rapid Symmetrical, or Universal Symmetrical, and Dallmeyer's Rapid Rectilinear, are good types of the kind of lens required. On the continent, we, for the most part, prefer Steinheil's Rapid Aplanat, which, however, is a very expensive article.

Having now got our camera completely fitted, we require a base (fig. 4) for it, and, as I have before pointed out, circumstances must decide whether it should stand on the floor or be swung from the ceiling. In either case it is necessary that the framework should have two parallel rails, between which runs a square projection, fixed on the bottom of the camera. This guides the camera when pushed towards the copying board. By making the projection square the camera can be turned either way.

The copying board is fixed on a sort of easel standing on the rails of the base frame. Whether the easel should slide towards the camera is a

matter of choice. Sometimes a better light can be thrown on the board if it can be shifted forward, when copying at close quarters, and, moreover, it is then not necessary to bring the camera forward into the full glare of the studio light. The copying board must run in grooves, so as to be capable of being shifted sideways. The

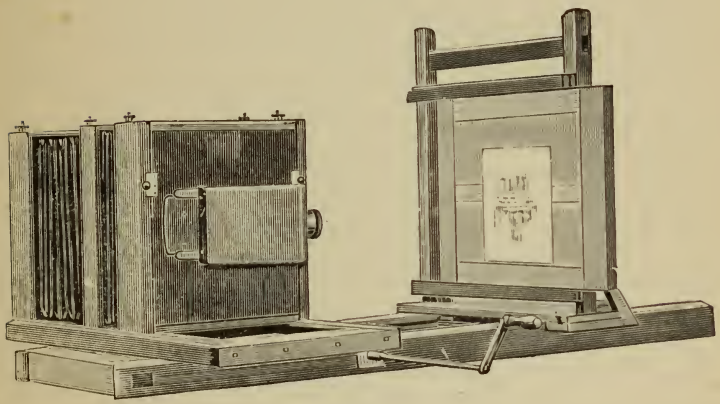


Fig. 4.

sides should project out beyond the base frame, because when copying with the mirror box in position the latter is not central to the base frame, and the copying board must be pushed forward to strike a centre to the lens. The copying board should be of soft pine, so that it is easy to stick pins into it, but its ends should be clamped with oak.

Chapter III.

THE SCREEN.

The screens now universally in use are cross-lined, with transparent squares between the intersections of the lines. It was formerly the practice to use a single line plate, and to reverse the direction of the ruling by turning the plate a quarter revolution midway in the course of exposure, but this method is now obsolete. Screens formed of dots, instead of lines, have also been tried, but abandoned by all practical workers.

The old plan, by which the operator made his screens by copying from the proof of a copper plate ruled with lines, has also been quite superseded, owing to the great perfection attained by the American manufacturers, to whom I hereafter refer, in the production of ready-made screens.

The choice of a screen really becomes a simple matter when there are only two makers of any consequence, and the productions of both are excellent. The makers I refer to are: Levy (of Philadelphia), and Wolfe (of Dayton, Ohio), for

both of whom Messrs. Penrose & Co., London, are agents in this country. The essential point of difference between their respective productions is that in the case of Levy the lines are engraved in the glass by means of a diamond point, set in an engraver's ruling machine, which accurately spaces the lines to any desired number to the inch. The cutting is done through a waxen film, so that when completed the lines may be further deepened by exposing them to the action of fluoric acid, which etches the bare glass away, leaving the parts covered with the waxy film untouched. The furrows thus formed are filled in with an opaque black pigment. Two single line plates, ruled in opposite directions, are generally taken and sealed together, so that they form a cross hatching.

Wolfe's screens, on the other hand, are copies by contact from screens made by some similar method to the foregoing. They are carefully made on collodion dry plates, and are practically as perfect as an original ruling. The only possible objection that can be urged against their use is that, being formed of a silver photographic image, they are liable to lose density or become discoloured in course of time.

There can be no doubt that the Levy screens are by far the most popular, and their quality and utility are certainly beyond question. Moreover,

a much greater selection of sizes and rulings is offered by this manufacturer, and his trial sizes, which are small pieces produced in the cutting up of larger plates, offer the beginner a ready means of experimenting without incurring very great expense. Wolfe's screens are not made less than $8\frac{1}{2} \times 6\frac{1}{2}$, whilst Levy's may be had down to $4\frac{1}{2} \times 3\frac{1}{2}$. A further point to consider is that Wolfe's screens are bound together with a black paper edging like a lantern slide, and this takes away about half an inch each way from the standard photographic size for which they are made. Levy, on the other hand, does not adhere to standard photographic sizes, cutting his plates from large sheets to best advantage. Thus, a plate bought as $8\frac{1}{2} \times 6\frac{1}{2}$ will be quite 9×7, and without any binding, so that the full area of a whole plate negative may be taken with a whole plate screen.

The question of the size of screen to be purchased must be determined by the size of the camera and the means of its owner, for large size screens are very expensive. But the ruling is a matter which comes within my duty to advise. By the ruling I mean the number of lines to the inch. In determining what is best the intending purchaser must consider what class of work he is likely to do. For rough newspaper printing 85 or 100 lines to the inch is the right thing. For general work 120 or 125 lines to the inch. For

fine printing 133 or 150 lines. There are also rulings of 175 and 200 lines to the inch, but the making of blocks from these is a work requiring the greatest skill, and the printing must be of the most perfect description, such in fact as is not usually attained in this country. Fig. 5 will enable a comparison of different rulings to be made.

For average work there is nothing better than 125 lines to the inch, which makes a good all-round screen, neither too fine nor too coarse. Such a screen in whole plate size will cost £6 10s. 6d., but if one is content with a trial size, a piece $8\frac{1}{2} \times 5\frac{1}{2}$ will only cost £3 2s. 6d.

With regard to the proportion of black to white in the ruling—that is to say, how thick the black line should be compared to the transparent space between—practical men are at variance, and where specialists disagree the beginner had best be content with the ruling the maker ordinarily gives. Levy rules his black lines usually two-thirds the thickness of the transparent space, and Wolfe's screens have a much thinner black line, not more than half as thick as the white. I am inclined to think myself that a proportion of two-thirds black to white is scientifically correct and is calculated to give the best gradation.

The screen having been selected it will be necessary to have a carrier made for it so that it may fit in the dark slide. This will be a carrier

of the ordinary shape, but with turn buttons to hold the screen from falling out. The position of the screen carrier in the dark slide has already been explained.

Screens should be put away in a preserving box when out of use, and being valuable it is just as well to have them under lock and key to prevent accidents from meddlesome hands. The

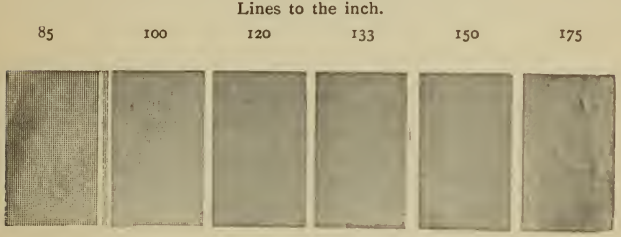


Fig. 5.

surfaces should be kept perfectly clean, and in polishing care should be taken to avoid scratches. A very soft piece of wash leather, an old cambric handkerchief, or a piece of soft tissue known as "papier Joseph," are things which suggest themselves as best to polish with. Bear in mind that a dirty screen will never give good results.

Chapter IV.

THE DARK ROOM.

Much of the success of half-tone work depends to a great extent on having a properly appointed dark room. It will not do to set apart some stuffy little cupboard for the purpose. One must have a comparatively large and well-ventilated room. Its entrance should be situate preferably at that point of the studio nearest to the back of the camera. It will be well to make the room quite half as large as the studio itself, if possible. To match the studio planned in Chapter II. the size of the dark room would therefore be 6 ft. × 9 ft., and, say, 8 ft. high.

Assuming that this size is decided upon, I should recommend that two sinks be fitted up, with a partition between, so that one compartment could be used for wet plate work and the other for dry plates, for if the latter are to be used it is advisable that they be kept away from the wet plate sink.

Some workers prefer a wooden sink with a

section like this (fig. 6), such a sink should be lead lined. But on the whole I think that the earthenware sinks are least trouble, most durable, and easiest cleaned. Such a sink can be set low down with sloping splashboards around it, and so be practically the same as the wooden one illustrated.



Fig. 6.

The size for working 15×12 dishes should not be less than 30×20. A wooden grid should be made to stretch across to rest the dishes on whilst developing, etc. It is best to arrange to have a shelf at the back of the sink to place bottles and developing cups upon, as there is not much likeli-

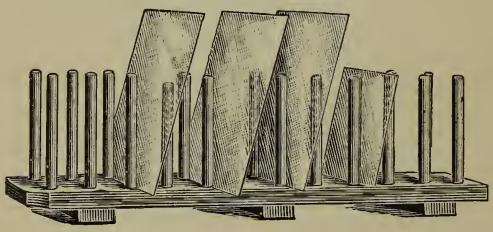


Fig. 7.

hood of their being knocked over in such a position. Plenty of elbow room is wanted, and it is a mistake to have the sides of the sink filled with bottles, etc. Underneath the sink may be a rack for dishes. A good form of rack for plates is as

here illustrated (fig. 7), formed of pegs of wood stuck in a plank. This should be fixed as a shelf high up in the dark room, where it will be out of the way.

The silver bath should be placed nearest the shelf on which the dark slide is placed for filling. If a dipping bath (fig. 8) is used, as I recommend

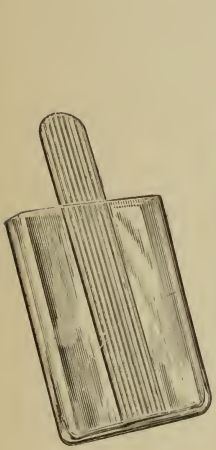


Fig. 8.

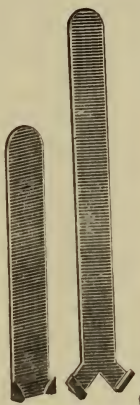


Fig. 10.



Fig. 9.

for beginners, the mouth of it should be level with the bench, and if possible part of the bench should be hinged, and the bath placed underneath this, so that the bench forms a cover for the bath, to be lifted up when the bath is in use. The bath should be placed as far away from the sink as possible, but in a place where a good light falls

upon it from the dark room window, so that one can easily see to place the plate in. Wooden cases for the bath (fig. 9) are sold by dealers. The dippers may either be of ebonite, of either of the shapes as fig. 10, or of glass.

It is a good plan to have the cyanide solution in a dipping bath at the side of the sink. This bath should also have its mouth just level with the bench, under a lift-up flap. As noxious fumes



Fig. 11.

are given off from a cyanide bath it is best to have a tight fitting cover.

The dishes for wet plate work should be large enough for the fullest size plate the camera will take, as developing is not done in dishes, these only being required for purposes of intensification, etc. They should be of the deep kind.

A set of graduates, comprising 40 oz., 20 oz., 16 oz., 10 oz., 8 oz., 4 oz., 2 oz., 1 oz., 60 minims is a necessary part of an outfit. Likewise scales and weights from $\frac{1}{2}$ grain up to 1 lb. Two sets will be

required—grain scales weighing from ½ grain up to 2 drams, and pound scales weighing from ¼ oz. to 1 lb.

An argentometer (fig. 11) is a necessary part of a wet plate outfit. By its means the number of grains of silver in each ounce of bath solution is determined. As the bath gets weaker by use, it may be tested by this instrument and fresh silver added to bring it up to strength again. The continental argentometer registers per centage of silver in the solution instead of the number of



Fig. 12.

grains per ounce. When purchasing one of these instruments it should be ascertained which method of reading is adopted.

A pneumatic plate holder (fig. 12), which attaches itself to the plate by suction is a useful article. It should be of solid red rubber, as this form is the most durable and powerful.

Several glass stirring rods will be useful.

Funnels are also wanted. I recommend one large glass one, say about 10 inches diameter for silver bath, and it should not be used for anything else. A second glass one of medium size, say 6

inches, will serve for general purposes; and a third, say 4 inches, should only be used for collodion. For the intensifier I think it is best to use a papier maché funnel, as it cannot be mistaken, and so used for any other purpose. It is, of course, very good to have a few other sizes of funnels, but the above will be enough if economy is desired.

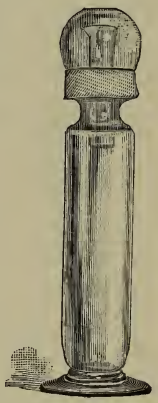


Fig. 13.

There are some handy developing cups of glass to be had. They nest within one another, and are sold in sets of three, large and small, being of thick toughened glass they are very durable. These cups are good for pouring the developer on to the plate.

A gallon white glass bottle will be required for containing the bath solution when out of its

trough for filtering or any other reason. This bottle should not be used for anything else. Being of white glass it is useful for running the bath.

Three or four Winchester (4 pints) bottles are necessary. One for the developing solution, two for the intensifying solution, and one for general use. Don't keep a lot of unnecessary bottles in the dark room. They only make the place more difficult to keep clean and free from dust.

A cometless collodion bottle (fig. 13) is a decided help to clean negatives. It is a tall glass bottle, a large cap covering the neck and pouring lip, so that dust cannot adhere and find its way on to the plate. The inner neck descends some way down into the bottle, so that when pouring the liquid on the surface only runs out, the sediment from the bottom of the bottle being caught by the projecting neck. The tallness of this bottle assists the precipitation of any sediment in the collodion.

It is always better to let collodion settle rather than filter it, but if for want of time it must be filtered a collodion filter bottle should be at hand. The old-fashioned shape is as fig. 14. The bulb at the top is stoppered and in the bottom of it is a neck that will fit into the bottle. Inside this lower neck of the bulb is placed a tuft of cotton with a glass tube passing through and descending nearly to the bottom vessel. This lets

a little air through which helps the filtering. Fig. 14a is another form in which filter and pouring bottle is combined. The inner funnel descends nearly to the bottom, and a piece of muslin is tied over the end. All the liquid poured out must therefore pass through this filtering medium.

An outfit of negative glasses will be required.



Fig. 14.

The sizes will be dependent on the capacity of the camera to be used. It is hardly worth while having anything smaller than half plate, as it is an understood thing in wet plate work to use a plate a size larger than the picture really requires, it being almost impossible to preserve clear margins. Patent plate is by far the best to use, but it is

very expensive. Flatted crown is next best, but a good substitute for either is polished sheet, which is reasonably cheap and fairly flat and well polished. Common window glass should never be used.

A cupboard with shelves for stock bottles of chemicals, and a drawer for sundries will be an acquisition, and will enable the operator to keep the dark room tidy.



Fig. 14a.

The window of the dark room should be in front of and as wide as the sink, and the bottom of the window level with the crown of the operator's head. The window should be of one pane of glass, but of two thicknesses with a double thickness of canary medium cloth between the two glasses. This forms a safe light for wet plates and slow dry plates. If the window looks out on another apartment it is a good plan to have a gas bracket at the other side for night work.

The water supply of the dark room is a very important consideration. If there is no continuous supply from the mains a large cistern must be fixed up overhead. This cannot well be too large if one wishes to avoid the risk of a failure in the water supply. The standpipe over the sink should have a swinging arm with rose, also a connection for a short length of rubber tube for swilling out the sink, and a small arm with narrow mouthed tap for filling bottles. A fitting comprising these

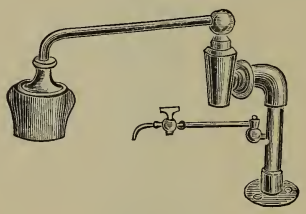


Fig. 15.

requirements can now be bought ready made at the photographic material dealers (fig. 15).

One of the gas burners which can be turned down without going out is a most desirable fitting in a dark room (fig. 16).

The ventilation of the dark room is a more important matter than most people appear to think. Not only does a perfectly ventilated dark room add to the comfort of the operator, but it also contributes in a large measure to the success of the delicate processes worked therein. Work

done in a properly ventilated dark room maintained at an even temperature will be much more uniform than it would be otherwise. Where there is a gas bracket in a dark room the fumes can be carried away and a current of air drawn through at the same time by having a ventilator immediately above the gas bracket; the outlet of the ventilator being if possible in the open air. It must be

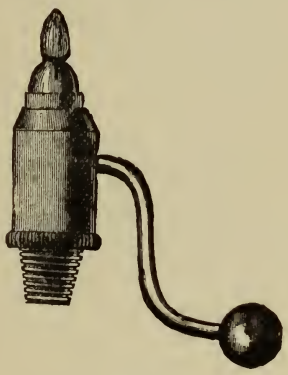


Fig. 16.

borne in mind that wherever there is a ventilating outlet there must also be an inlet for the fresh air, and the most convenient way of arranging this is to have it in the lower part of the door by means of a few holes built through the door, and an inner panel arranged so as to cover up the light coming through them without obstructing the passage of air.

Another matter to which attention must be directed in building a dark room is in regard to the prevention of dust, which occasions great difficulty in some processes. An effective way of minimising it is to have the walls and ceiling covered with varnished matchboarding, or papered with varnished paper, to have all the shelves smooth and varnished, and benches covered with lead or zinc, the floor being laid with linoleum, which should be washed at least once a week, and damped and swept daily.

Chapter V.

THE PRINTING ROOM.

In using the term "printing" it must be understood by that I mean the act of transferring the photographic image from the negative to the metal plate, and in the room described as the "printing room" are conducted all the operations appertaining to this part of the process. In many small workshops a portion of the dark room is set apart for this purpose, but it would be better to have a separate room, if space can be afforded, for although printing is very often a duty that falls upon the photographic operator it is better even where one man does both things to give him separate rooms so that the appliances for one process do not get in the way of the other.

A room about the same size as the dark room already described, will be sufficiently large, though for preference it would be better that it be broader than 6 ft., as a bench about 24 inches is required down one side of the room.

The bench should be very substantial and in

the centre part of it should be a wooden sink, lined with either lead, pitch, or gutta percha, and of good depth. In front of the sink, or properly speaking, behind it, should be a good window, with a yellow screen or yellow blind, so that daylight or yellow light may be let in at will. Preferably the door should be as far as possible from the sink, as a precaution against light and dust.

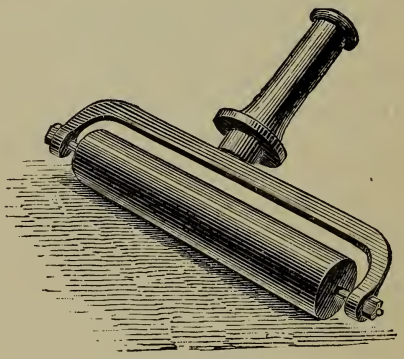


Fig. 17.

Upon the bench to the right hand of the operator should be the measures, bottles, beakers, and funnels required by the printer.

To the left of the sink should be a gas stove of the ordinary cheap circular pattern, but one that will give a good spreading flame. The gas connection should have a tap for regulating the flame. If the fitting already exists without a tap

it will be possible to put a spring clip of some sort on the rubber tube to attain the same object.

On another part of the bench well away from the stove and sink a couple of litho stones must be placed, one for the ink, and the other with a pad of sheet rubber on it, the object of this being to hold the plate from slipping about whilst it is being inked, the stone providing a firm bed.

Behind the ink slab or underneath the bench should be a cupboard to keep the composition roller used for this process free from dust. In the same cupboard may be kept the ink. The roller



Fig. 18.

will keep better if there is a little ventilation in the cupboard.

The roller should be of the letterpress kind (fig. 17) with forked handle, and the composition of a water-resisting nature, and not too soft. If tacky it will not resist the damp. A roller may be made damp proof by first cleaning any ink or grease off with turpentine, then washing with methylated spirit, applied with a sponge, and when dry sponging it with a solution of chrome alum or tannic acid.

A palette knife (fig. 18), for mixing; an ink

knife for taking the ink out of the tins (fig. 19); and a "push" knife (fig. 20), so called by reason of its being pushed forward to scrape the ink off



Fig. 19.

the slab, are required. Also a bridge to rest them on when smeared with ink (fig. 21).

A drawer for dry chemicals, cotton wool, etc., the latter an important item in this department,

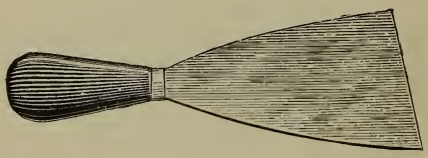


Fig. 20.

is requisite. The best quality of cotton wool is known as absorbent. It may be identified by a crunching feeling when held in the hand. This



Fig. 21.

wool has been freed in process of manufacture from all greasy matter, and so readily absorbs water.

A tournette, or whirler, is an important accessory in this room. At least I consider it so, though some workers boast that they never use one. Various forms of whirler have been advocated, but there are two leading types which are equally good, and as each have their advantages it may be advisable to have both. The turntable one (fig. 22) is very good, but its disadvantages are that as the plate has to be whirled face

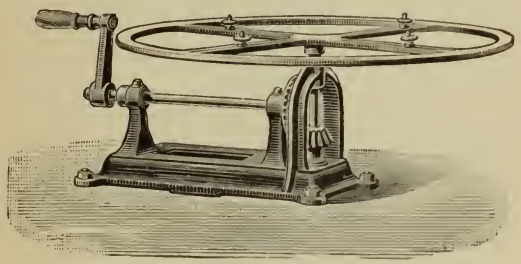


Fig. 22.

upwards it is liable to attract dust; further that unless there is a guard around it there is a great deal of splashing about the room and upon the operator; also that the plate cannot be quickly detached. Its chief advantage is that it will firmly hold plates as large as its table, and, of course, the table may be made any size.

In the other form (fig. 23), the plate is very readily attached to the pneumatic holder and the instrument can be easily held in the hand and the

whirling done in the sink with the plate face downwards, so that splashes are retained in the sink, and dust is avoided owing to the sink being always damp.

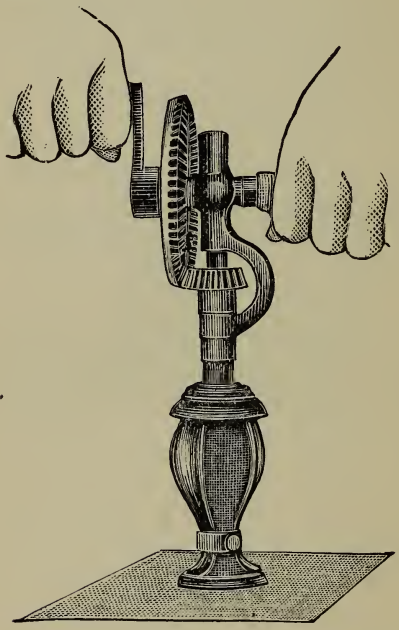


Fig. 23.

A requirement in connection with the printing room is the polishing board, but if there is not space enough to keep it well away from the coating bench it had better be outside this room as it will generate dust.

The polishing board may be simply a flat clamped board covered with glazed American cloth, which prevents the plate slipping about, or the board may have a thin raised strip around it to prevent the plate slipping off. More elaborate arrangements for holding the plate have been devised. For instance, the old-fashioned glass plate holder (fig. 24) like a parallel vice suits very well. Another I have seen was in the shape of a shallow box with an open top and a couple of rails across the top to rest the plate on. One rail was

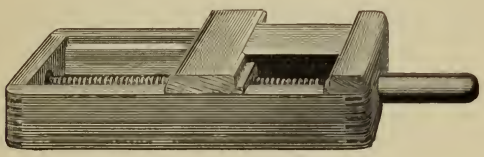


Fig. 24.

fixed and the other could be moved up into notches at various distances. A rebate corresponding to the thickness of the plate was cut in the meeting edges of the bars, so that the plate was held from slipping off. The idea was right enough if the plates are cut to standard sizes, but as the zinc is cut to any odd measurement to fit the picture such an arrangement would hardly be practicable. There is no reason why the vice should not be combined with the open box to receive the surplus powder.

For some methods of half-tone we require a graining bath. This may be either a porcelain dish on a rocker or a small etching tub. The porcelain dish can be made use of as a makeshift, but the plate is liable to slip about and an uneven grain is produced. The best arrangement of all would be a light wooden tray with a rocking arrangement actuated by a small clockwork or electric motor so that whilst the plate is being grained other things could be got ready. A pendulum has been suggested, but it would have to be a very large and long one to rock for any appreciable time. If the tray is a wooden one it must, of course, be pitched or coated with gutta percha to stand the acid. The tray should be as large again in area as the largest plate to be used.

Chapter VI.

THE ETCHING ROOM.

Almost any well-lighted and well-ventilated room will do for etching purposes, but if I were building a room for this express purpose I should, for preference, have it on the ground, with the floor laid in concrete, and in erecting the roof give it a ventilating ridge the whole length. It is not necessary to have the lighting from the top; it would be best to have a long, lofty window down each side. One end would receive the entrance, the other would take in the flue for the hot plate. Down one side of the room under the window would be the etching tubs, and on the other side the inking-up bench. This I think most practical etchers would approve of.

With respect to the fitting up there would be on the side for the etching troughs first of all in the corner near the door a stool of about 12 inches high for the acid carboy, the latter to be fitted with a syphon (fig. 25). There are various forms of syphons to choose from. An ebonite one

with taps and suction pump is the best, but most expensive. A glass one of the same pattern may be had for half the cost, but requires careful handling. There are cheaper glass ones in which the suction necessary to start the syphon is done

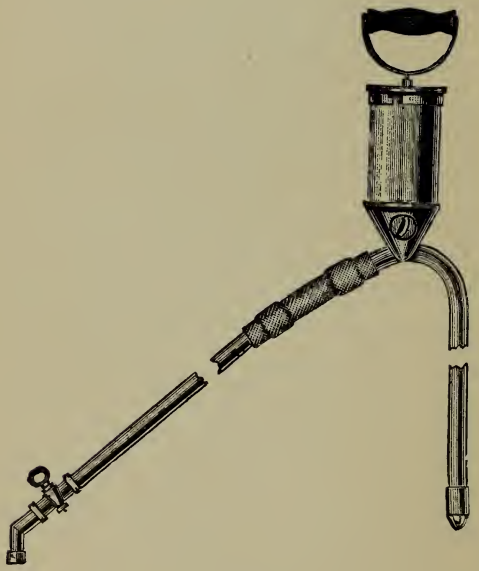


Fig. 25.

with a pneumatic ball. Again, a cheaper one still is one that is filled with water, and holding a finger tip over each end it is dexterously dipped into the acid at one end and the water running out of the other draws the acid with it. In any

case have a syphon of some kind if you are using a large carboy.

Next in order comes a good roomy sink (fig. 26). A deep earthenware one is the most durable, but a wooden one pitched inside may be readily

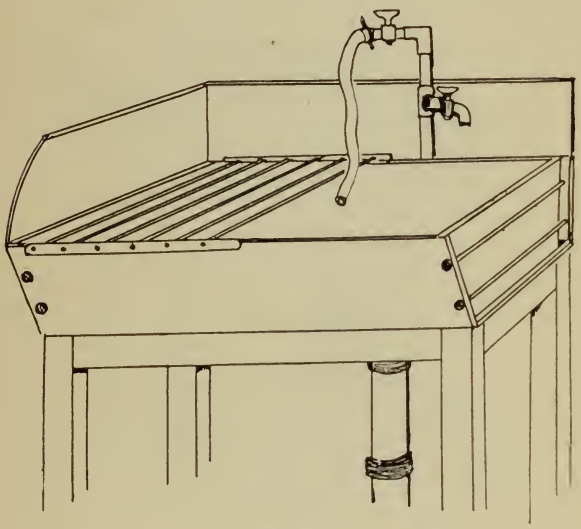


Fig. 26.

made. Lead lined sinks are very soon eaten up despite the idea that nitric acid does not attack lead. The drain pipe should if possible be of earthenware for the same reason. At one end of the sink, covering about one-third of it, should be a grid made of quarter inch iron rod placed about

1½ ins. apart. This is for scrubbing the plates upon with potash, turps, etc. It will get such a greasy coating in use that there is little fear of its rusting, so that it is a great deal better than wood. A stand pipe fitted with tap, rubber hose, and rose sprinkler, each, if possible, with separate con-

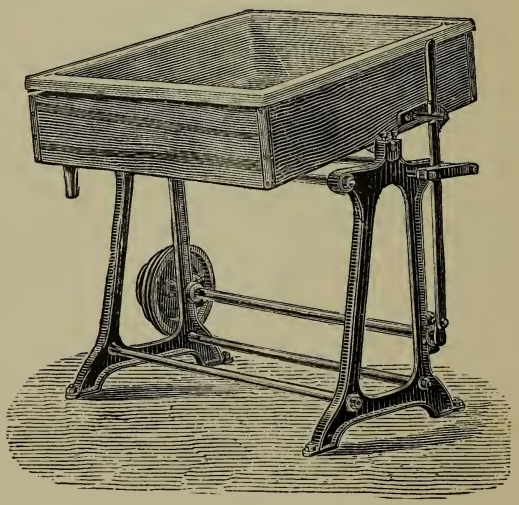


Fig. 27.

nections will form the water supply, and it should be fixed clear of the scrubbing grid, so that it will not be in the centre of the sink. Next the sink and sloping down into it I would have a slate slab, slate resisting acid well. If separate etching troughs are used cradle fashion I would recom-

mend a slate slab for the whole length of the bench.

If any large amount of work is to be done it will be better to have a mechanical rocking stand with a row of baths upon it. Various methods will suggest themselves for obtaining the rocking motion. Where power can be obtained it may be done by means of an eccentric and connecting rod on the overhead shafting, or the eccentric may be placed on the driving axle of the stand, or on the

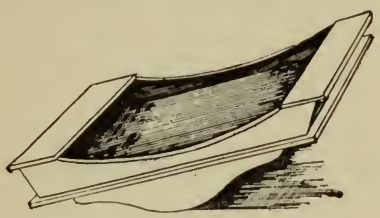


Fig. 28.

pivoting axle. Here is an illustration of a stand for a single bath for either hand or power (fig. 27).

Next must be considered the size and shape of the baths and of the material of which they are made. The wooden box shape with a splash board over each end is easy in construction, but it is not satisfactory as the square ends cause splashing. Sloping ends (fig. 28) are much better, giving a more even wave. In either case wooden baths must be coated with pitch or lined with sheet gutta percha well jointed. The lining

with gutta percha should be done by a manufacturer of rubber goods, but the pitching may be done at home, though my readers will be well advised if they avoid the operation and buy a ready made tub.

The baths that will last a lifetime, unless broken, are the earthenware ones. There is one pattern of German manufacture with ends sloped and turned over (fig. 29). These are very good and cheap. Messrs. Doulton also make a bath of the sink shape with covered ends to

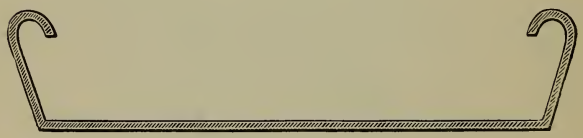


Fig. 29.

prevent splashing. These baths have a bung in at the end for emptying, but the German ones have not. The solution might, however, be got out by syphoning. By having Doulton's baths on a stand and a gutter arranged just under the bung hole there will be no necessity to ever take them off the stand, and there will therefore be no risk of breakage.

For filling the bath it will be best to have a can of known capacity. Still better would it be to have a can or jug to measure one hundred parts —these may be ounces or any other quantity. If

the metrical measure be adopted a litre jug would answer admirably. By this means the acid may be added at a strength of so much per cent. without any troublesome calculation. It is much better than working by rule of thumb.

There are etching brushes to be obtained which are very useful for removing the scum from the zinc. The proper article is rather dear. It is



Fig. 30.

made of the finest camel hair, or better still, badger or marten fur, which is of a greasy, acid resisting nature, bound flat in leather (sewn, not nailed to the handle) and set in shellac, the handle being thickly coated. Small round ones without leather binding, known as "ätzpinsel" (fig. 30) in Germany and Austria, are to be had more cheaply and are of badger or marten. In default of these a good quality of flat camel hair dusting brush

may be taken and the handle thickly coated with shellac varnish.

At the end of the room will be the hot plate. This will be a planed cast iron plate standing on a brick foundation if possible, somewhat like a blacksmith's forge. In small sizes a ready constructed article (fig. 31) may be had. A larger size may be made by taking a printer's iron imposing surface and standing it on a box of brickwork, with only a trap in front for lighting up the gas rings and a ventilating shaft behind. It must be borne in mind that to get uniformly diffused heat in such a plate there must be a deep turn-down rim around it in order to concentrate the heat. The illustration of the smaller stove shows this well, and it may be copied in the larger plate by bending around the plate a descending rim of sheet iron and rivetting the same on. Also remember that there must be ventilating holes on a level with the gas rings, or the burners will be put out by the absence of pure air. It is a good plan to have two or more rings, each with a separate tap, so that only a part of the plate may be heated if not all is required. A sheet of asbestos board is a good thing to lay on the hot plate to modify the heat. One or two pairs of large pliers should be hung up near the hot plate for handling the plates when hot.

Running down the other side of the room will

be the rolling-up bench. It should not be too high or it will not be possible to get a good downward pressure on the roller. The top of the bench should be quite $1\frac{1}{2}$ in. thick, and well supported underneath, so that it does not spring when the roller is knocked up on the slab. A few drawers underneath are useful for containing fresh supplies of rags, sponges, and sundries.

To fit up this bench we require first of all on

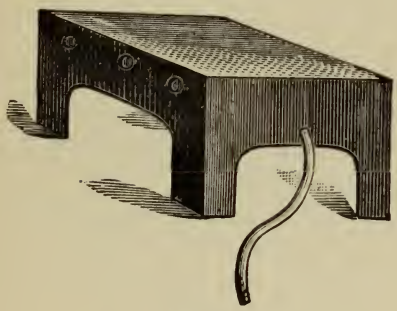


Fig. 31.

the end near the hot plate a planed iron surface to act as a cooling slab. Iron is better than anything else for cooling purposes, and the larger the slab the less chance there will be of its becoming warm by constantly laying upon it the hot zinc plates.

Next to this will be a rolling-up slab, which will be an old litho stone of good size, with a sheet of indiarubber cloth on it to prevent the plate slipping about. Adjoining this will be an ink slab,

this also being an old litho stone. At the back of this some sort of rack should be formed for the rollers. A simple way, however, of standing the rollers, is to drill two or three holes in the bench large enough to put the handles through.

The rollers will be at least two for each workman: one a "nap" leather roller, and the other a glazed one, both of the litho type (fig. 32). These rollers are formed of a solid cylindrical block of soft, light wood, with handles of a harder wood well driven and glued into the block. The latter is first covered with flannel, and over this calf-skin leather. In the case of the "nap" roller the smooth or skin side is placed inside, the "nap" having a more or less rough surface which holds the ink. To prepare a new roller for use it must first be rubbed with Russian tallow before a fire, heating the roller well and rubbing the fat in until it will absorb no more. Next apply some "strong" litho varnish, and knock up well on the slab until the varnish is evenly distributed on the roller. Now scrape the varnish off with a blunt knife held nearly at right angles. If the knife seems to drag and ruffles the nap, it will show that you are scraping the wrong way of the grain. It is just the same as stroking a dog or a cat the wrong way. Turn the roller round, and scrape towards the other handle. If the scraping goes smoothly, mark the handle to which you are scraping, and

always scrape this way. After this varnishing, the roller is daily rolled up with litho ink, and scraped until ready for use.

The glazed roller may be one with the skin side outwards, and rolled up in an ink mixed with some hard and quick-drying varnish. When perfectly dry, smooth down with glass paper. Simple as this method of preparing a glazed roller appears, it is hardly likely to be satisfactory enough to fit the roller for immediate use; because the

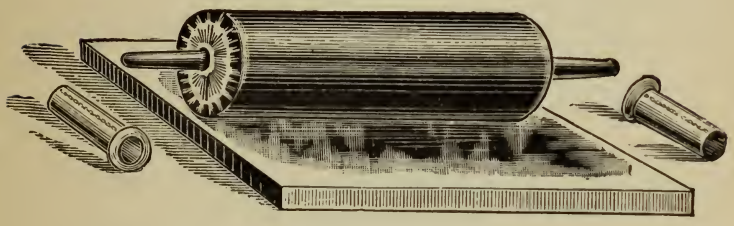


Fig. 32.

skin side of the leather always shows wrinkles which cannot be filled up. Experienced etchers know well that a good glazed roller is an old lithographic colour roller which has become glazed and hardened by use.

Roller handles are formed of tapering tubes of leather which fit on to the handle of the roller and so prevent the hands becoming sore through friction.

An indiarubber roller is favoured by some.

It is also of the litho type, and should be smooth and hard. Handled rightly, it is capable of inking-up the most delicate work quite as well or even better than a "nap" roller. A hard, well-seasoned composition roller on litho stock is also useful, especially for proving.

Of course, more slabs and more rollers will be required, according to the amount of work to be done and the number of hands working at the bench. It is advisable to have separate slabs for each kind of ink, and covers for them, so that a good deal of time is saved which would otherwise be occupied in cleaning-up and in re-mixing inks. It is also good to have separate nap rollers for litho and etching inks.

An ink knife for taking the ink out of the tin, a palette knife for mixing, and a push knife for scraping the slab are requisites; and a little bridge of wood should be nailed to the bench to rest the blades on when covered with ink, so that they will not daub the bench. These articles are illustrated on pages 43 and 44.

A few basins of the household kind, known as pudding basins, are required for holding water and gum.

In the corner of the room at the end of the bench will be the dusting box for the resin, asphaltum, and similar powders (fig. 33). The light wooden grid inside is for resting the plate on. The resin

is thrown in the bottom of the box, and is taken up as wanted on the brush, or the plate is pushed under it. The lid forms a hood closing up three sides, and so preventing the resin flying about the room. It would be a good plan to have the bottom of the box in the form of a tray or drawer, so that it may be withdrawn and other drawers containing other kinds of powder substituted. A flat camel hair brush should be placed inside the box for

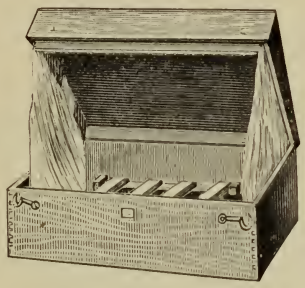


Fig. 33.

dusting; and outside, hanging up somewhere conveniently near, a second brush of fairly stiff but flexible hog's hair bristles for brushing off the surplus.

Respecting the lighting arrangements the long window will be a good light by day, and a gas bracket with universal joint over each etching trough and each rolling-up slab will be requisite, unless the luxury of incandescent electric light is

provided, as may readily be done where there is an electrical installation for the studio.

The windows should not be made to open, as this would drive in a lot of dust on the ink slabs and work in hand. All ventilation should be obtained from the roof.

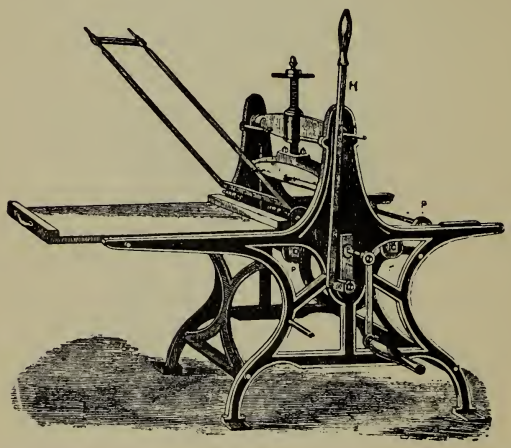


Fig. 34.

The hot plate will probably provide all the warmth required in the winter time, and it will be best if it can be made to do so, as a coke or coal stove will certainly generate dust—the arch enemy of the half-tone process.

If there is space to spare, it is desirable to have a press in the etching room for taking proofs

from the plates when operations are completed. It is much better that the etcher should be able to see the effect of his work as soon as etched, so that any faults may be remedied before it leaves his hands. A litho press (fig. 34) will do very well for taking proofs from plates, and as it is much cheaper than a type press, it may on the whole be recommended.

Chapter VII.

THE MOUNTING ROOM.

The mounting of the blocks is very often associated with the etching room, but this is not to be advised, as the sawdust and chips of zinc get into the ink and are embedded in the rollers, causing a great deal of trouble. If it is not possible to have a separate room, a place ought to be at least partitioned off from the etching room.

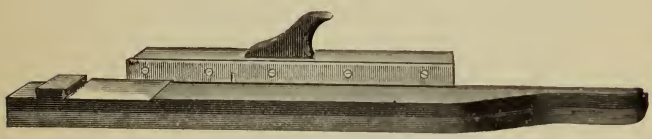


Fig. 35.

The chief fitting for the mounting room is a long bench, substantially built, and placed in a good light. At the back of it should be a rack for tools.

Upon the bench we shall require the shoot board (fig. 35) for planing up the edges of the zinc blocks, and for rebating the edges of the plates so as to sink the nail heads below the surface. The

best forms of these shoot boards are of cast iron, with two heavy metal planes, one for the side shooting, and the other for the bevel or rebate; but where there is not a large run of work, wooden planes with metal facing will do very well if set on a suitable board. In any case, the planes and board should be such as are expressly made for the work, or built by someone who understands the nature of the work to be done. It is no use trying to temporise with an ordinary carpenter's plane.

Mounting board can be bought machine



Fig. 36.

planed to guage, so that it is no good bothering oneself with planes and boards for backing the blocks. To preserve its flatness, mounting board should be suspended on hangers from the ceiling, with two or three laths between each plank to allow of free circulation of air.

A slab of planed cast iron, or, better still, of rolled iron about 15 × 12 inches at least, is a very useful adjunct to the mounting bench. It is termed a knocking-up slab, and is useful for beating the plate flat if slightly bent, and for punching-up holes in the plate, as will be described in the

instructions for mounting. A special kind of callipers (fig. 36) is used for marking the position

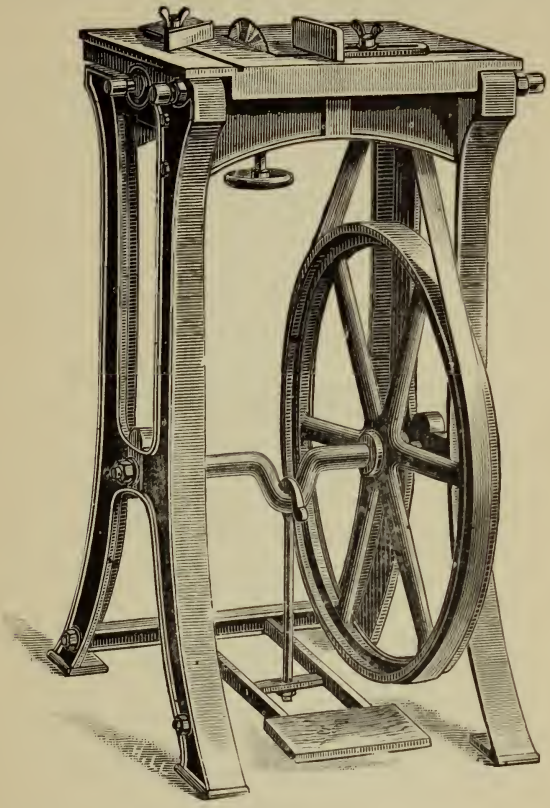


Fig. 37.

of holes to be punched up.

A lead punching block is required. About

six inches square will do, but if larger, so much the better. It is used for punching the nail holes in the zinc plates with a sharp punch, this method being quicker than drilling if the plates are thin. It is well to have an archimedian drill also, with some fine bits. Three punches are required: one is sharp and highly tempered for punching the holes; one with a flat end about $\frac{1}{16}$th diameter, for driving home the nails; and one with a broader head, about $\frac{1}{8}$th inch, which is termed a vignetting punch. Three hammers of 4 ounces, 8 ounces, and 16 ounces weight of head will be necessary—



Fig. 38.

the first a carpenter's hammer, and the two last engineer's hammers.

A 36-inch steel straight-edge, a good steel or boxwood rule, a carpenter's square, an engineer's steel square, a pair of steel dividers, and a special pair of callipers with long legs, as illustrated, are among the requisites.

Half-a-dozen stereotyper's chisels, assorted sizes up to $\frac{1}{2}$ inch; carpenter's chisels, of $\frac{1}{4}$, $\frac{1}{2}$, and 1 inch; and a dozen assorted gravers and scoopers will complete the edge tools. A hand saw and a tenon saw will be useful, though sawing ought to be done with a treadle circular saw (fig. 37) if in

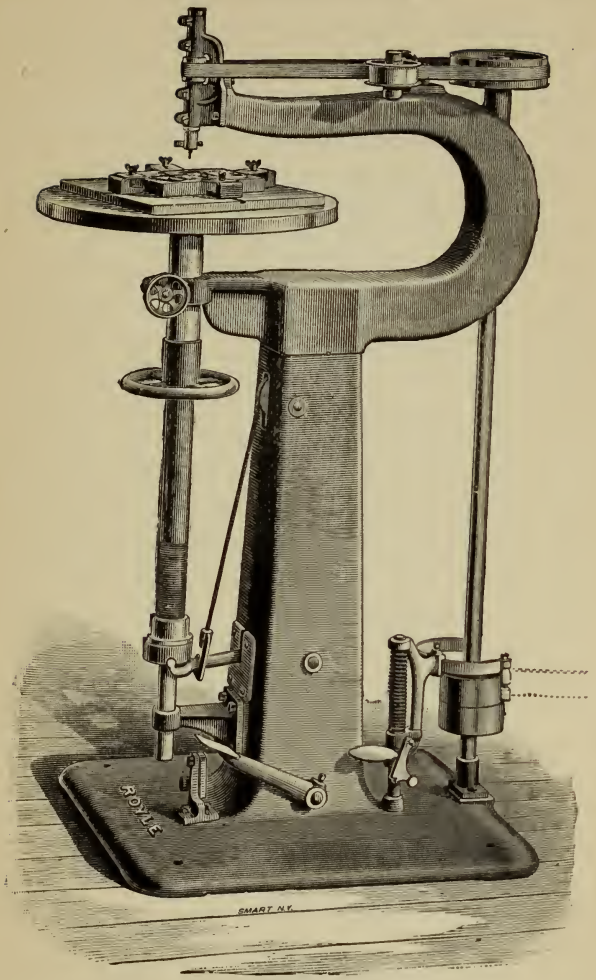


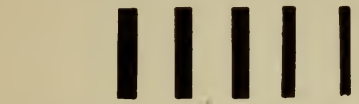
Fig. 39.

any quantity. Fret sawing is sometimes resorted to in vignetted work. This may be done with a hand fret saw, but here again foot power is best. The zinc may be cut up for use with a tool known as a zinc hook (fig. 38). A deep score, guided by a straight-edge, is made in the zinc, which is then snapped.

In large workshops a routing machine is a valuable accessory, and such machines are largely used in America, where their manufacture has been brought to a high degree of perfection. The principle of all forms is that of a rapidly spinning cutter of peculiar shape which is brought into contact with the plate, and either the plate is moved about under the tool, or the tool is moved about over the face of the plate, wherever it is needful to sink large spaces. The illustration (fig. 39) shows a simple form of such a machine. It is well, in fitting up the mounting room, to lay in a good supply of useful tools, whether actually required for the processes or not, because the mounter can then fill up his time as the handy man of the establishment.

It will be the business of the mounter to cut up the zinc or copper for use. The most usual gauges of the plates as measured by the Birmingham Standard Wire Gauge, are 14, 15, or 16, though as a rule 15 is ignored, 14 is used principally for line work, and 16 gauge has

become the accepted thickness for half-tone plates. Copper is also used 16 gauge, but 17 or 18 gauge is frequently adopted. The following diagram shows comparative thicknesses :—



Gauge Nos. 14 15 16 17 18

Part II.
THE OPERATIONS

Chapter VIII.

NEGATIVE MAKING.

The information given in the preceding chapters will have enabled anyone commencing to work the half-tone process to fully equip the atelier with all the necessary plant. All that now remains to be done is to lay in a stock of chemicals and sundry useable materials. The wants in this direction will be discovered as my instructions proceed.

We will begin with the dark room, by making up the silver bath. The size selected will, of course, be proportionate to the dimensions of the largest picture the camera will take. The bath selected should be of white glass, not of deep green like bottle glass. The capacity of the bath should first be determined by measuring water into it until filled. We will presume it is an 80-ounce bath. The strength of silver required is 40 grains to the ounce. A simple multiplication sum shows us that 3200 grains of nitrate of silver is required, = 7 ounces, 2 drams, 17½ grains, avoirdupois.

Better get at least 8 ounces, as some will be required for replenishing the bath as it becomes weakened by use.

To prepare the bath, take 80 ounces of distilled water, and to a portion of this in a clean white glass bottle add the silver, shaking up till all dissolved. Then add 15 grains of potassium iodide (the proportion is about half a grain to every 100 grains of silver) dissolved in a little water. Shake up thoroughly, add the remaining water, filter the whole, and add 30 minims of pure nitric acid. The solution, if now tested with blue litmus paper, should turn the latter slightly red. The funnel used for filtering the bath should always be kept for that purpose, and the bottle in which the solution was mixed should likewise be reserved for emptying the bath into.

The beginner will be well advised to buy a collodion of some well known make, but those who have had any experience in collodion manufacture may make up the following, which is a well tried formula :—

Pyroxyline	120 grains.
Ether, Sulphuric	5 fl. ounces.
Alcohol, sp. g. ·805	5 ,,

To bromo-iodise above, take

Iodide of Ammonium	40 grains.
Iodide of Cadmium	40 ,,
Bromide of Cadmium	20 ,,
Alcohol, sp. g. ·810 to 815	5 fl. ounces.

After making the above solutions, mix, let the resulting solution stand for a week, and carefully decant off the clear solution into the pouring bottle for use.

The developing solution is as follows :—

Protosulphate of Iron	2 ounces.
Glacial Acetic-Acid	2 ,,
Water	40 ,,
Alcohol, Methylated	1 ounce.

After the bath has been used about a week it will be necessary to add another ounce of alcohol to the developer; and the older the bath becomes the more alcohol will be required, up to four ounces for the quantity of developer given. It must always be remembered that the object in having alcohol in the developer is to make it flow over the plate. A film sensitized in an old bath repels an aqueous developer, which consequently flows in a greasy, streaky manner over the plate, but the addition of alcohol overcomes this tendency.

The fixing solution is cyanide of potassium, in the proportion of 1 ounce in 40 ounces of water. A little in excess of this strength is not of any consequence.

The most suitable formula for intensification is the following :—

Sulphate of Copper	2 ounces.
Bromide of Potassium	½ ounce.
Water	20 ounces.

Nitrate of Silver	60	grains.
Citric Acid	10	,,
Water	2	ounces.

With the foregoing solutions prepared, we may now proceed to business.

Glass plates of suitable size should be cleaned by first immersing in water to which a little hydrochloric acid has been added, then well rinsing, and afterwards rubbing with a soft rag charged with a paste formed of finest powdered tripoli and methylated spirit, finally polishing with a clean chamois leather. To ensure the film holding well to the glass, it is best to run a margin of thin indiarubber solution around the edge of the plate to the extent of about a quarter of an inch, this being done with a small camel hair brush.

Leaving the dark room for a while, let us get the camera ready. See that the mirror is clean, and quite free from dust. If the inside of the camera is at all dusty, wipe it out with a damp chamois leather or sponge. Fix up your drawing or photograph upside down on the board (it always seems easier to focus an image which is the right way on the ground glass). Focus it to extreme sharpness; if there is no sharp detail in it by which you can focus, pin up a bit of print alongside it and focus upon that. The focussing should be done with full aperture. It will, of

course, be necessary to insert a stop, but instead of the usual diaphragms with circular apertures, cut a fresh set with square openings, the sides of the square being parallel to the sides of the plate. To determine the size of these openings, draw a pencil line around the edge of the opening when the stop is laid upon a piece of cardboard. Then make a square inside this circle (fig. 40).



Fig. 40

The image having been focussed, insert one of these stops. It is not likely that you will be able to use one larger than that corresponding to *f*/16.

Next see that your screen is properly fixed in its carrier and inserted in the dark slide. Normally, it will lay in the dark slide with the plates or wire corners touching the similar metallic corners of the sensitive plate carrier. This will be a little too near to get the full effect

of the exposure, and a cardboard cut-out mount in the shape of the carrier should be inserted between. This should separate them about $\frac{1}{32}$ of an inch.

Polish the screen both sides with a very soft chamois leather, using the same care as you would to polish a lens. The glass of which Levy screens are made is very susceptible to being scratched.

Now take your dark slide into the dark room and stand it up conveniently for putting in the plate. Lay in the bottom corners of the plate carrier pieces of blotting paper to receive the drainings of silver solution from the plate.

You can then proceed to collodionize your plate, and lower it into the silver bath. These are elementary operations which I shall not more particularly describe. Those who are unacquainted with the wet plate process should read up some good handbook on the subject. My aim in these instructions is to only explain those operations which differ materially from the ordinary method of working.

An immersion of from two to three minutes in the bath will be sufficient to sensitize the plate. The plate is then lifted out, drained on a pad of blotting paper for a moment, and then inserted in the dark slide, care being taken in all these operations to avoid getting dust on the film.

The dark slide having been inserted i n

camera, uncap your lens and let the exposure proceed. It will be abnormally long, so that you will have plenty of time to calculate its duration. First of all decide what your normal exposure would be without screen or mirror. Then double it to account for the latter factors, and add as much again to allow for the proper spreading of the dots. This will give you a rough approximation of the exposure necessary. It is not likely that you will over-expose. To get the best effect of the light, it is well to spread a sheet of white paper on the bed of the copying stand just under the board; this will reflect the light upward, and prevent the grain of the paper of the original showing up if at all rough. Likewise, if one side is unequally lighted, it is advisable to put up paper reflectors.

The period of exposure being complete, return your dark slide to the dark room. It is well during the exposing to get ready your developer, and to see that everything is at hand for the development, as the plate will have a tendency to dry during these long exposures, and no time must be lost in getting it developed.

Attach the pneumatic holder to the back of the plate to lift it from the dark slide, and the holder will be a good support while developing, as anyone acquainted with wet plate work is well aware that it is impossible to use a dish for

developing. The developing solution must be poured on in such a way that it will immediately flow over the whole plate without hesitation. Any marks caused by stoppage of the flow will be fatal to a half-tone negative. Nor must any of the solution be spilt from the plate, as we want all the silver we can get to build up the image. If the exposure is correct, the picture will come up brilliantly in a very short time, and then will slightly dull all over. It is no good prolonging the development beyond this stage. Pour off the developer, and examine the negative with a powerful focussing magnifier by transmitted light. The point to determine is whether the dots in the high-lights are joined or nearly joined in a sort of chess-board effect. If they are very wide apart the negative is under-exposed, and it is useless going further with it. Assuming that they are right, give the negative a rinse, and immerse in the cyanide solution until cleared. If left in too long, the image will be attacked.

Wash the plate thoroughly in running water for at least five minutes. Then pour on the bromide of copper solution until the image is bleached white. Wash again thoroughly, and apply the silver solution, which will turn the negative a rich black. Give the plate a rinse and again examine it with the magnifier. If the dots are not quite joined up at the corners (fig. 41)

continue the washing for about five minutes, and then apply a weak solution of cyanide of potassium, and, after washing, the copper solution again; wash, and repeat the blackening with silver. The dots should now be joined unless it is a refractory case of under-exposure, or of the screen being placed too near. A third application of the intensifier may even be made, but before each subsequent application the weak cyanide solution must be applied and the plate washed. If the negative is over-exposed and the spaces between



Fig. 41.

the dots veiled, flow the negative with a solution of iodine in iodide of potassium, and afterwards with the cyanide solution.

After the final washing, the plate is dried off with gentle heat if hurriedly required, and then varnished either with a well filtered gum solution or with a "water varnish" made by boiling 80 parts of white shellac in a solution of 20 parts of borax in 1000 parts of water, and filtering whilst hot.

The plate is now ready for printing, though

some operators prefer to cut through the film the ruled border line for the picture.

It may be expected that I should give some hints on the use of dry plates for the work, as many operators of the present day are more familiar with their use. I must, however, state at the outset that it is more difficult to make a good printing half-tone negative on a dry plate than on a wet plate, but this is chiefly because the usual makes of dry plates are not suited to the particular conditions of the work. The common fault is that the shadows veil over before the necessary density can be obtained. This may to some extent be obviated by using some of the modern developers, such as eikonogen, metol, or glycin. The latter gives especially clear shadows. In general, it will not be an insuperable difficulty to get a printable negative on a dry plate, if the operator is at all accustomed to the methods of producing dry plate negatives of a high-class character. But, as a rule, a dry plate negative takes a little longer to print.

The difference in the exposing of dry plates will be that the plates should be backed with some anti-halation medium—a piece of gummed orange paper or wet carbon tissue are as good as anything. The camera must be quite light-tight, and there must be no stray light or reflections in it. A smaller stop must be used—the next size stop—

than for wet plate, and the screen must be placed just a little nearer to the plate. The exposure will be proportionately longer, say about one-third, than for wet plate, after all other conditions have been allowed for; that is to say, if the sensitiveness of the two kinds of plates was equal, and the stop used the same, the exposure necessary to bring about the effect of the screen would be one-third longer for the dry plate. The reason of this is because the screen is placed somewhat nearer, and the requisite joining of the dots has to be produced by the development, and cannot readily be secured by intensification, which should be avoided with dry plates. If a slight veil should be produced in developing to full density, a clearing solution should be applied. This may be simply two or three crystals of ferridcyanide of potassium added to a clean hypo solution. Quantities not necessary to be exact. Of course, it is hardly necessary to remind those intending to use dry plates that the light in the dark room should be safely non-actinic.



Photo by E. H. Baldry, *Grasmere.*

HALF-TONE ETCHING ON BRASS.

BY THE AUTHOR.

Levy Screen. 133 lines.
Wet Plate Negative.
Enamel Process.

Chapter IX.

FAILURES AND REMEDIES IN NEGATIVE MAKING.

My work would not be complete were I not to point out the probable causes of failure in the foregoing process of negative making, and the remedies thereto. For the common failures of wet plate negative work I must again refer the reader to his photographic handbook.

Thin negatives will be due either to weakness of the bath, too much acidity in the bath, or to under-exposure. The latter will be the most likely cause if the bath, etc., have been recently made up. In a hopelessly under-exposed negative there will be no dots in the shadows, and the dots in the high lights will be isolated, *i.e.* there will be a transparent space around them, instead of being joined corner to corner. If the dots in the high-lights are properly joined up, but there are no dots in the shadows, the original is probably one with dark shadows and intense lights. With such a subject it is best to have the screen closer to the

sensitive plate, to insert a smaller stop in the lens, or towards the end of the exposure to move about the dark parts of the original a piece of very white paper. This will give intensity to the dots in the shadows.

Generally speaking, the rule for distancing the screen is:—

For light subjects, further away.

For dark subjects, nearer to.

Should the picture be strong and the screen effect blurred, the cause will be one of three things, *viz.*:—

(*a*) Screen too far away.

(*b*) Too large a stop.

(*c*) Lens of too wide an angle.

With a wide angle lens the light passing through the screen is refracted at too great an angle, and consequently the dots do not strike the plate squarely if the latter is some distance away. If the plate were brought so near as to touch, or almost touch, the screen, the dots might be secured sharply, but a very much longer exposure would be necessary to join them up. Hence, wide angle lenses are unsuitable.

Occasionally the screen effect will be blurred through the accumulation of moisture on the screen. This is caused by sensitizing the plate in a very warm dark room and exposing it in a cold studio, or *vice versa*. It is a trouble that is most

frequent in the winter time. It may be overcome by rubbing a little glycerine on the screen, and then polishing till nearly dry; or by warming the screen slightly. But the best way is to endeavour to keep the dark room and studio at the same temperature. This will obviate many other troubles.

In the hot summer time the plate will have a tendency to dry during long exposures. Experienced wet plate operators will call to mind such remedies as adding glycerine to the bath, which may be done under proper conditions. The beginner is warned to avoid such a remedy, as it is more than likely that he will spoil his bath. A simple way to prevent drying is to affix a pad of damp blotting paper to the back of the negative.

It is well when working under a skylight which allows the sun to beat on to the camera to stretch a white cloth a little above the camera to reflect off the rays. Blinds are to be avoided as far as possible in a studio used for reproduction, except when it is necessary to shut off patches of sunlight from the copying board or from falling into the lens. Secure all the light you can.

Stray light in the camera, from whatever cause, is to be guarded against. The screen is like a mirror, picking up all reflections, and wherever it catches any, there its working power will be marred, blurred effects being observable on the negative.

A good negative will have little contrast of the nature of ordinary negatives taken without the screen, that is to say, there will be no clear transparent shadows and intense high lights when the negative is held at arm's length. There will be a sort of dim, slaty tint over the whole, no solid blacks, yet the picture showing its detail quite plainly. Examined with a glass the dots should be intensely black, joined up, as I have already said, chessboard fashion in the high-lights, large and rounded in the half-tones, small and round in the shadows. Some workers prefer transparent shadows printing quite black on the zinc, but unless such negatives are printed very carefully there will be a very sooty effect when the block comes to be proved. There is no doubt that the "commercial" negative most aimed at in all large ateliers is as I have described, and this will give a block that will work well in the printing press.

Chapter X.

PRINTING FROM THE NEGATIVE.

For the purpose of making the necessary print on the metal we require a very strong pressure frame fitted with screws; a convenient pattern is that here illustrated (fig. 42).

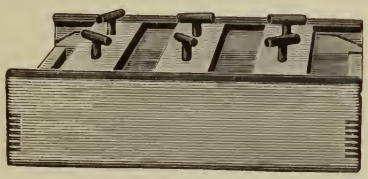


Fig. 42.

The front of the frame is a plate of glass at least five-eighths of an inch thick. This is carefully cleaned, and the negative laid upon it.

We now set about coating the plate with the sensitive solution. First, I will give the most simple method.

Take a piece of polished zinc plate, lay it upon your polishing board, and rub it, not too

harshly, with the very finest emery or pumice powder, applied with a tuft of cotton wool moistened with water.

Have ready an etching bath with a suitable quantity of the following solution in it :—

Water	100 parts.
Powdered Alum	15 ,,
Nitric Acid	1 ,,

After polishing give the plate a rinse and immerse in the above solution, rocking until an even matt surface is attained. Rinse under the tap, and remove the scum with a tuft of cotton wool.

Affix the plate to the whirler, and coat twice with the following solution, which must have been previously carefully filtered through a piece of cotton wool placed loosely in the neck of a funnel.

White of one egg, well beaten.	
Water	8 ozs.
Bichromate of Potassium	60 grs.

Dissolve the bichromate in one ounce of water, and add to the egg solution, thus making up altogether about 10 ozs. Add liquor ammonia drop by drop until the solution turns from a reddish colour to a bright yellow. This will keep at least a week.

The first coating must be thrown off into the sink, as it will be too much diluted with the water on the plate. Coat again, then start the whirler, slowly at first, then quicker, for a few seconds.

Detach the plate and dry carefully over the stove, allowing only a gentle heat to impinge on the plate, or the coating will be rendered insoluble. When the plate is fairly warm, blow upon it and the moisture should then be driven off.

When the plate has cooled down lay it in the pressure frame upon the negative, after carefully dusting the latter with a broad camel hair brush. Screw up tight, and if iridescent circles appear



Fig. 43.

between the negative and front glass of the frame, it may be judged that the pressure is right.

Expose to light, putting out at the same time some form of actinometer. The best form is as fig. 43. This consists of strips of paper, so arranged as to form steps, No. 10 being ten thicknesses of paper. This forms a mask behind which a piece of silver paper is placed. When a

certain number (found by experience) is attained the zinc plate will be ready. The exposure will probably be from 3 minutes in the sun to 15 or 20 minutes in the shade.

When it is judged that the exposure is complete, remove to the dark room, lay the plate on the rolling-up slab, and with a composition roller (fig. 12) ink the plate all over with a thin, even film of transfer ink, which should have been previously thinned down with rectified turpentine and evenly distributed on the ink slab. The rolling of the plate should be commenced when the roller begins to make a sucking noise on the slab. It is important that the ink be not laid on too thickly, or there will be a tendency to smudge. The ink used may be either photo-transfer or lithographic re-transfer "stone-to-stone" ink, either of which is bought ready for use.

The turpentine must be allowed to evaporate from the ink. Then immerse the plate in a dish of clean cold water, and with a piece of cotton wool, well moistened, wipe the plate gently with a circular motion. If the negative has been of the right density, and the exposure has been right, the surplus ink will clear away, leaving the picture sharp, clear and black. In case of under-exposure portions will wipe away, and with over-exposure it will be impossible to get the picture clear. If the excess of exposure is not too great, it will

sometimes be found effective to add a little liquor ammonia to the washing water.

When the picture has been brought up clear on the zinc, rinse, and fan the plate with a square of cardboard or other means until dry. Then dust on to the plate very finely powdered asphaltum, brushing out the surplus with a soft bristle brush. Hold the plate over the stove until the dull matt appearance of the asphaltum turns glazed. When cool, the plate is ready for the etcher.

Another way is, after developing and drying the plate to dust with powdered resin of the finest degree obtainable, and heat in the same way. This is an indispensable preliminary to the "dragon's blood" process.

If it is intended to follow the "rolling-up" method, the plate should not be dusted; it should be dried and coated with a thick gum solution, made with the best gum arabic, and allowed to dry spontaneously, or only fanned to accelerate the drying. The subsequent operations will be taken in hand by the etcher.

The foregoing methods are most suitable for open grained work, and where speed of production is an object. For the finest results recourse must be had to bitumen printing, which, however, is very slow and often uncertain in dull weather.

Ordinary commercial bitumen is unsuitable in its natural state for printing purposes. It has

to be purified by washing with ether until all the least sensitive constituents are washed out. This is a tedious and expensive operation, very difficult to accomplish satisfactorily. I shall not, therefore, trouble to describe it, especially as purified bitumen can now be easily and cheaply obtained from dealers in materials for the half-tone process.

A convenient strength for the bitumen solution is 30 grains to the ounce. The solvent is highly rectified benzole, though some workers prefer to use a mixture of benzole and chloroform. Chloroform is the most perfect solvent, but it evaporates too rapidly. The best way will be to dissolve the bitumen in two parts chloroform, and add three parts benzole. The benzole must be perfectly free from water; even a wet bottle will sometimes spoil it. To prevent the benzole or other solvent evaporating too rapidly, and the film becoming brittle, it is usual to add a few drops of oil of lavender. Others add a very small quantity of Venice turpentine, but care must be taken to avoid an excess, or the coating will stick to the negative. The theory of adding Venice turpentine is that the purification of the bitumen takes away the sticky properties, so that the film may become pulverulent if the purification is carried too far. The Venice turpentine is accordingly put in as an inert substitute to hold the film together in development. The solution should be filtered

through cotton in a closed filter.

The coating may be done with a whirler, but no time must be allowed for the plate to evaporate. The turning must be commenced without the slightest delay; also the turning must not be too quick, or a star pattern will be formed on the plate.

Another way is to select a plate larger than required, pour a good flow of bitumen along the edge nearest to you, and then quickly allow it to run to the opposite edge by inclining it and allowing it to run off into a trough, whilst the plate is held perpendicular. Only the best part of the plate must be used with this method.

It is advisable to dust the negative with powdered talc (French chalk) to prevent it sticking to the bitumen.

A common practice in bitumen printing is to sensitize a large plate and to strip the negatives by means of a coating of indiarubber solution, followed by stripping collodion, and to squeegee a number of films on to one plate. The films are first immersed in glycerine. If well squeegeed down the films will hold, and no pressure frame is needed.

The colour of a suitable bitumen coating will be a rich golden hue. A very faint image is sometimes visible before development. The latter is accomplished with turpentine, which is flowed over. If the print refuses to develop it may be

assisted with a piece of cotton wool gently rubbed over it. The moment all the detail is visible under the scum of turps and washed-out bitumen, the plate must be placed under a strong rose tap until all the greasiness is washed away, and the image shows sharp and clean. Then the water can be blotted off and the plate set up to dry. If allowed to stand in the sun it will be strengthened. Then it is ready for the etcher.

Another method of printing is by the transfer process of photo-lithography. It has the advantage of not requiring the use of reversed negatives, but in other respects it cannot compete with direct printing on zinc. Suitable transfer papers for this purpose are manufactured by Jaffé, of Wien, whose agents in England are Messrs. Penrose & Co. The brand of paper used is that known as "Eagle Brilliant." It is sensitised by immersion in a bath of one ounce of potassium bichromate to twenty ounces of water. Liquor ammonia is added drop by drop until the solution is turned a light yellow. The temperature should be between 66 and 68° Fahr. The paper is drained and dried by squeegeeing into contact with plate glass. Printing is done in diffused light, and on removal from the frame the print is inked up with photo-transfer ink thinned down with poppy or nut oil. The surface is blacked all over with a very thin coating of ink, applied with

a velvet roller, the ink having been previously distributed on the slab with a composition roller. Next immerse in a dish of cold water for 15 minutes. Lay the print then on the rolling-up board or slab and pass the velvet roller over it again, when the ink will be picked up from the whites tolerably clear. Then go over the print with a damp sponge, wiping with a crosswise motion, until the whites are quite clear. Allow the print to dry spontaneously. Next dust over the surface with a powder composed of one part beeswax in ten parts asphaltum melted together and ground very finely. Brush off the surplus with a soft brush, and hold the print face down over a spirit lamp until the matt brown colour of the picture changes to a matt black. The print is then ready for transferring to zinc by the usual lithographic method.

Of late much attention has been given to a process which was given in the number of *The Practical Photographer* for April, 1893, copied from an American paper. The formula given for this process was as follows :—

Fish Glue	2 ounces.
White of Eggs	2 ,,
Ammonium Bichromate	120 grains.

The eggs are well beaten up with two ounces of water, and two ounces of Le Page's fish glue stirred in. The bichromate is dissolved in two

ounces of water, and added gradually to the egg mixture, stirring all the time. Let the solution stand for an hour or so, then filter through felt.

The copper or zinc plate is freed from greasiness by rubbing with a tuft of cotton wool dipped in a paste of water and zinc white, and polished to dryness. The filtered solution is flowed on the plate, and the first coating poured away into the sink. Then flow again and fix the plate to the whirler, and turn slowly at first, gradually increasing the speed until the surplus is thrown off. Flow again, and repeat the whirling. Then dry with gentle heat, and when the plate is cool print in the same way and for about the same time as for albumen.

When the plate is printed put it in a tray full of water, let it soak for a couple of minutes, then wash well under the tap until the dots are isolated. Now flow over with alcohol, and allow to dry. The next procedure is to take the plate in pincers and hold it over a gas stove until the colour changes to a rich deep brown. Intense heat will be required to effect this—almost on the point of melting the plate. When cool, it is ready for etching.

In practice, it will be found well to immerse the plate in an aqueous solution of aniline violet dye when developing. This will render the image strongly visible. The amount of bichromate given

in the formula is too much ; half the quantity will be quite enough. A good thick coating must be obtained on the plate, especially with zinc, or the proper colour will not be reached when burnt in, and the plate will not resist the etching. Further, it is necessary to have a good dense negative for this process. The process as it stands cannot be said to be commercially practicable. Serious difficulties present themselves, and only those who have had experience in other methods of printing are able to secure anything like satisfactory results.

Various successful modifications of the above process are no doubt in use, but are for the most part kept secret by the firms working the same.

Pure white gum acacia may be substituted for the fish glue, and any of the bichromates will do. With the gum formula chromic acid has been added with advantage. Generally speaking, all these processes, in which the film is enamelled by burning-in, are more suitable for copper than for zinc, the former metal bearing the intense heat better than the latter. Brass has also been used for the purpose. Its price is between the two other metals.



Photo by *Hanna, Auckland.*

HALF-TONE ETCHING ON ZINC.

BY THE AUTHOR.

Levy Screen, 133 lines.
Wet Plate Negative.
Enamel Process.
One Etching.

Printed on
Grosvenor, Chater & Co.'s
Acme Art Paper.

Chapter XI.

THE ETCHING.

In all the methods of printing described in the last chapter we have left the plate at the point where the etching should begin.

The first process we described left the plate with a homogenous coating of melted bitumen powder on the ink. The etcher taking this in hand would first of all give it what is termed a "pass" through the acid, that is to say, he would immerse it in a very weak acid bath, not more than one per cent., giving the bath a rock two or three times, so that the surface is just dulled. The plate is quickly rinsed and dried by fanning or blowing upon it. In this condition the plate will take any retouching better than if it had not been "passed." If the ruled border line was not cut on the negative, it should be ruled upon the plate now with a mathematical ruling pen charged with either Lemercier's lithographic writing ink or with a solution of common asphaltum. The Lemercier's ink is sold in oblong cakes, and should

be rubbed on a warm saucer in which is a little distilled or rain water. Hard water must not be used, as there is soap in the ink, and this would curdle. The proper consistency must be judged by trying the ink on the margin of the plate with pen or brush. The bitumen ink is made by dissolving the asphaltum, previously well powdered, in rectified turpentine, adding a little gum mastic and a little white wax. The exact proportions cannot be given, and they are not, in



Fig. 44.

fact, important, the ink being made up to a consistency sufficient to allow it to run freely from the pen without spreading. With either of these inks the spotting, ruling, and other retouching is done, and the name of the engraver put in if it is a business block.

To ensure neatness in lettering the name, line guages (fig. 44) are used. These are small blades of steel, somewhat like a short length of watch spring, notched at the end to form two or three

points as the case may require, and these blades are set in brass holders about the length and thickness of a retouching brush. When these gauges are run along a straight edge they make two or three fine parallel lines on the surface ruled upon. Lettering drawn between these lines can be made with the letters of even height. A three line gauge is used for capitals and small letters, and a two line gauge for capitals only. There are a dozen different gauges in a set of each kind. It must not be forgotten that lettering must be drawn backwards on the plate. Therefore, it is best to

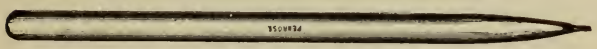


Fig. 45.

have the name gauged and properly sketched out on a piece of card, and to lay this against a mirror so that it may be seen reversed by the retoucher; or, of course, this copy may be drawn reversed, and kept for use always. A badly lettered name on a block is an eyesore, and proper attention ought to be given to this branch of the work. The lettering may be done either with a Gillott pen or with a Number O sable brush. The latter is used for all-round retouching.

Should there be any black spots on what should be the light parts of the picture, or if any of the dots are joined where they ought not to be,

such defects should be remedied with an etching point (fig. 45).

The next step is to varnish the back of the plate with an acid-resisting varnish, which is usually made up by dissolving shellac in spirit. Such a varnish can be bought ready for use under the name of "acid-resisting varnish." The margins of the plate, within about a quarter of an inch of the border line, are also painted with this varnish. As it runs rather freely, care should be taken that it does not run into the work. Stand the plate up to dry, and meanwhile add one per cent. more acid to the bath you have used for "passing." On the margin of the plate scrape away a thick line about half an inch in length. This exposes the zinc to the acid, which etches away a place where the depth of the etching may be tested by feeling with the thumb-nail. This I shall refer to as the "guide mark." The plate may now be put in the acid and etched until a perceptible depth can be felt in the guide mark. It is impossible to give a certain time for etching, owing to differences caused by temperature, the quality of the zinc, the purity of the acid, and the strength of the resist on the plate. The work must be carefully watched, and if any tendency to over-etching is apparent, the plate must be quickly taken out and rinsed and dried.

When the plate is dry it is sponged over with

thick gum, to which has been added about a quarter of its bulk of a solution of gallic acid. This is allowed to dry, or may be fanned dry.

A good plan for drying the plates is to have some apparatus for giving a cold blast of air. A

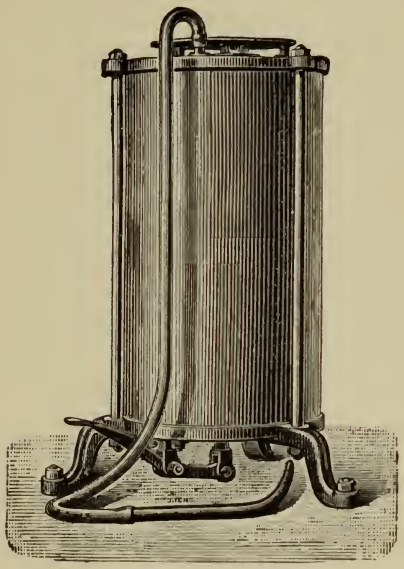


Fig. 46.

suitable arrangement of this kind is a foot blower, as fig. 46.

While the gum is drying, distribute a little soft etching ink on the slab by means of a "nap" lithographic roller. The soft etching ink consists

of resin and beeswax incorporated with printing ink. It used to be the invariable custom for etchers to make their own ink, but as very good ready-made ink can now be bought cheaply, this unpleasant duty may be avoided.

Should the ink be too thick it may be thinned down with "middle" lithographic varnish, but care must be taken not to make it too thin, or the work will be clogged up. Nor must there be too much upon the roller. If there is too much ink on the roller, the latter must be scraped as described in Chapter VI. The roller should be always put away with the ink on, and scraped before using.

The gum on the plate is moistened with a sponge, and then surface wiped with a pad of damping rag, wetted and well wrung out. Now roll the roller over the plate with a gentle but firm pressure, and not too quickly, backwards and forwards, lifting the roller and giving it a turn after it has passed to and fro over the plate. After five or six runs of the roller over the plate it will be necessary to re-damp the plate with the rag. Then continue the rolling, and repeat these operations until the picture is a full rich black, yet without any filling up. If the picture shows a tendency to clog, sponge the plate with gum, wipe with the damping rag, and roll quickly. It is well to remember that quick rolling takes the ink off, whilst slow, heavy rolling deposits it thickly.

Sponge with clean water and rinse the plate after rolling. Dry off, and dust with finest powdered resin. Heat the plate and continue the etching with one per cent. more acid, but before putting the plate into the bath make another guide mark as a test for the depth of the second etching. The depth to be attained will be about the same as the first, and when this is accomplished the total depth ought to be sufficient. But a further etching, known as "finishing," is requisite. The plate is made hot, and then scrubbed with strong lye of caustic potash, using a stiff bristle brush. The plate should be made quite clean and bright, without the slightest trace of ink between the dots. Place upon a clean slab a small quantity of hard etching ink, sometimes called "finishing" ink, and distribute with the glazed roller, thinning the ink, if necessary, with a little rectified turpentine. There must be only a very thin film on the roller, and with no lumpiness or patchiness, nor must there be any dust or grit. The roller must not be applied to the plate until the turpentine has evaporated. The plate must be laid on a clean surface, so that the roller may not pick up any dust. Roll very gently and steadily, using no pressure, only requisite firmness to lay the ink. If the ink does not take very readily, warm the plate a little. The rolling should be continued until the picture is strong and black. Then warm

the plate until the matt of the ink changes to a glossy black. Whilst the plate is cooling add 100 per cent. more water to your bath, it being necessary to have it weaker for this operation. Now give the plate a further slight etching. The object is not to deepen, but to clean up the work by removing raggedness from the shoulders of the dots. The duration of the etching can only be determined by watching the result. It will not, at any rate, be a long time. The plate is then cleaned with potash, and dried, when it is ready for the prover. If the proof should show a deficiency of contrast, resort may be had to what is known as "fine etching."

This requires to be done by an etcher with some amount of artistic perception. The parts which are considered to be sufficiently etched are painted out, or, technically speaking, "stopped out," with a black lac varnish, sold as "stopping-out varnish." This is applied after the plate has been rolled with "finishing" ink, as already described. More or less fine sable brushes are used for the stopping-out, and one must not attempt to be too detailed in the painting. We must adopt a style which painters would call "washy." There must be no clean, straight edges to the stopping. One must try to finish up near the boundaries of the shadows. The etching is continued with the same bath, and here again judgment is the only guide.

If necessary to soften down the edges, where the stopping-out finishes it may be necessary to enlarge the area of the stopping-out after the first biting, and so gradate the edges of the shadows or half-tones into the high-lights. This method is adopted with vignetted work. Vignetted effects are also further finished off to a soft edge by means of tint tools, *i.e.*, gravers cutting a number of lines at one shoot (fig. 47).

Reverting to other methods of printing the image on the zinc, we may take up a plate which has been dusted with fine resin as a preliminary



Fig. 47.

to the dragon's blood process. Such a plate when taken in hand by the etcher is first warmed slightly to make the resin tacky, and the plate is then dusted with the powdered dragon's blood. As there are several qualities of the latter, it may be stated that only samples which are of the most vivid red are suitable, and these are expensive. Inferior samples are adulterated, and look more like brick dust. The powder is well brushed into the lines with a soft brush, and the surplus brushed away with a stiffer brush, such as badger or fitch hair. The plate is then heated until the redness

of the picture changes to black. Retouching should be done before the powder is applied. The back of the plate and margins are varnished, the guide mark made, and etching proceeded with exactly as described for the bitumen dusting, except that no rolling-up with soft etching ink is done. The depth is carried far enough to allow of the glazed roller being applied, and finishing and fine etching done as usual. The dragon's blood being a strong resist, it will stand fairly deep etching without side cutting.

Etchers who are well experienced in the use of the "nap" roller prefer in the rolling-up method not to have the plate dusted, but to reinforce the transfer ink by rolling. In this case the plate would be gummed with the gum and gallic acid solution, then wiped off and kept damp whilst being rolled with stiff litho ink of the best quality. When the picture is fully inked up the plate is washed and dried, and dusted with fine resin. Then a one per cent. bath is given for a short time, and the plate rinsed, dried, and heated to fix the resin. Then the subsequent operations are precisely as described at the commencement of this chapter.

In the bitumen process, after the retouching and varnishing has been done the plate is given a one per cent. bath for one minute. Then the plate is gummed and rolled in with best stiff

litho ink as in the last process, dusted with resin, etched again in two per cent. bath, heated, gummed, and rolled up again with soft etching ink, and etching commenced as usual.

If an image is put down to zinc by the transfer paper process, the plate is first warmed to fix the ink and asphaltum, then gummed and rolled up with litho ink, dusted with resin, again etched, and the subsequent etching is as page 106.

To etch a plate by the enamel process, if on zinc, retouching is done as soon as the plate is cool, the back varnished, and the etching done with a two per cent. bath. If the etching should show any tendency to attack the film before sufficient depth is attained, the coating must be cleaned off with potash after the plate has been made hot. The glazed roller with finishing ink must then be applied. Stopping-out may be done as already described.

In all methods of etching on zinc it must be understood that commercial nitric acid is the etching mordant. It is, like fire, a "good servant but a bad master," and its properties and effects ought to be well mastered by the etcher as a preliminary training.

When the print is made on copper, as is chiefly done for the enamel process, the etching mordant should be perchloride of iron. This is bought in hard, bright yellow lumps, but is readily

dissolved by pouring boiling water over it. Not more water must be used than will equal the weight of the perchloride to be dissolved. When the solution is cool it should be tested with a Beaumé hydrometer (fig. 48). This is a glass float ballasted with quicksilver or small shot in the bulb at the botton. It rises or falls with the



Fig. 48.

density of the liquid, and for the purpose of copper etching 35 degrees is the average strength suitable. At 40 degrees the solution will act too slowly, and at 30 degrees it will bite quickly, but unevenly. It is not necessary to rock the tray, which may be a deep porcelain dish. A slight brushing is admissible. Only one etching is

required for depth, but the glazed roller and stopping out brush may be resorted to if desirable.

"Fine etching" is only necessary and advisable in the case of poor originals, or where the negative from any cause is not up to the mark. Generally speaking, fine etching should be avoided.

It is desirable, to ensure regularity of etching, to keep the temperature of the etching room at as near 60° as possible.

Of failures there will be only two kinds, *viz.*, from clogging of the work with ink and powders, or from over-etching. The remedy is, greater care.

Chapter XII.

MOUNTING AND PROVING.

The only thing necessary now to be done with the plate is to mount it ready for the printing press, and to take a good proof from it as an evidence of its quality.

The margins of the plate are first sawn off with a circular saw, or cut off with the zinc cutter.



Fig. 49. Fig. 50.

The plate is then placed on the shoot board and planed up square and clean within a good eighth of an inch of the border line. Then feed it up to the bevelling or rebating plane and form the rebate (fig. 49) round the four sides, shaving the border line to an even thickness.

Take a sharp-pointed steel punch and stamp the nail holes through upon a block of lead, or drill them with an archimedian drill. Nail the plate to a piece of mounting wood, unsquared, and

saw up square with the circular saw. The proper kind of nails are as fig. 50. Then plane up the sides and ends of the wood smooth and true. If the mounting wood has been bought ready for use it will be unnecessary to try the height, though if it should be too high the block should be laid face



Fig. 51.

down on a pad of soft paper, and the back taken down with a sharp and well set jack plane, until the block will pass the type-high gauge (fig. 51). It is well to discover before the plate is mounted whether the wood is too low. If so, a sheet of paper or cardboard may be inserted between the plate and block.



Fig. 52.

The photo-engraver who wishes to secure the friendship of the letterpress printer should see that his blocks are well mounted.

In the case of vignetted work, the fret saw and routing machine must be used. The fret saw is first run around the outside of the plate, and

the router then applied for the large whites inside. Smaller whites which do not seem deep enough

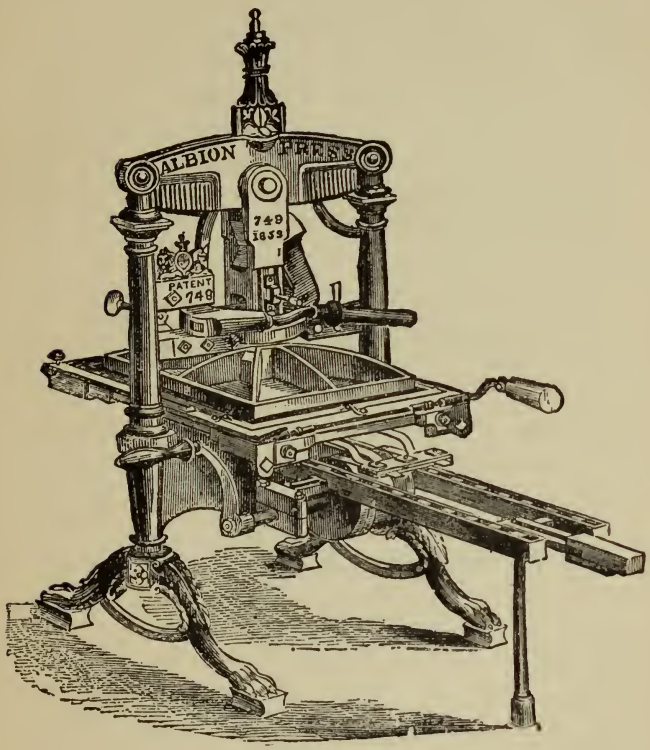


Fig. 53.

should be taken out with engraving tools known as scoopers (fig. 52), some being round and others flat, and of various sizes.

With vignetted work it is a good plan after the plate is nailed down to the block to beat down the edges which are intended to print light with a broad-nosed punch, that is to say, the edge of the plate is depressed, and so naturally prints lighter.

A first-class proof is now taken upon an Albion press (fig. 53); a good hard, and slightly tacky composition roller being used to apply the ink, which should be of the highest quality of black letterpress. It is better if there is a little blue in it, therefore "blue-black" should be



Fig. 54.

ordered. The ink should be as stiff as it can be worked, and must not be thinned down.

The paper should have an enamel surface, and is known as dull chromo enamel. It should be very slightly damp, which may be brought about by placing a quire of damp blotting paper at top and bottom and putting a board and weight on top.

In pulling the proof a sheet of good quality thin cardboard should be placed next the proving paper, in order to get a sharp impression.

Sometimes the proof may show a dot or two joined up in the high lights, having escaped attention in the previous processes. In such case the

dots should be run through with a knife graver (fig. 54). Shadows that are too dense may be lightened with a roulette (fig. 55). This is a small wheel bearing dots in relief, and when pressed against the plate and run along cuts a stipple on the surface of the plate. There are various degrees of fineness in these roulettes,



Fig 55.

and those should be selected which approximate to the ruling of the screen. The best maker of roulettes in the world is Renard, of Paris, and though one or two imitations have been attempted he remains so far practically without competition; he is unable to supply the demand and his roulettes are, as a rule, difficult to obtain.



Fig. 56.

When a part of a plate is over-etched, rendering the dots very minute, and thus giving high contrast, it is usual to gently rub the tip of the grain in these portions with a burnisher (fig. 56). *i.e.*, a suitably shaped blade of highly burnished steel. This broadens and consequently darkens the work. Likewise if the shadows of the plate should have become a little corroded it is usual to

burnish them bright. Any rouletting should be afterwards gone over with the burnisher.

It has been suggested, and several times tried, to give etched zinc plates an electrolytic coating of copper, brass, or nickel, so as to render them less liable to corrosion. This is quite practicable, but the trouble of working an additional process, and the fact that the customer would hardly care to pay anything extra for it has deterred most photo-engravers from undertaking this further duty. Brass and nickel will have to be deposited with a battery, but a superficial coating of copper may be applied by neutralising copper sulphate with a strong alkali, such as ammonia or cyanide. The plate is well washed with caustic potash, and then immersed in this solution for a few minutes, when it should be found coated with a sufficient covering of copper. Copper plates may be made to look very presentable by immersing in a solution of cyanide and silver. A cyanide fixing bath which has been in use for some time for plates will do very well.

It may be added that, of course, whatever applies to the mounting and proving of zinc plates equally applies to copper, except that the tools must be sharpened, and in every way in good condition to cut this harder metal.

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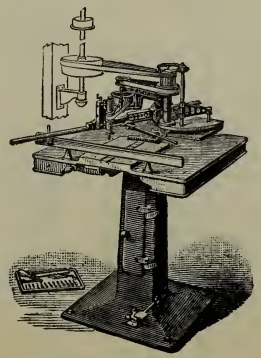
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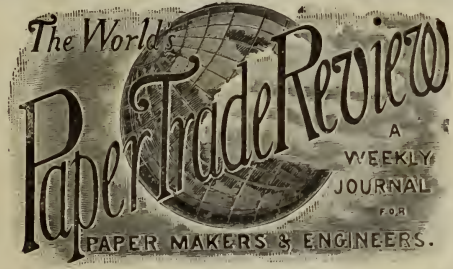
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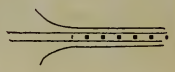
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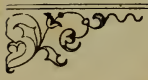


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